

CHAPTER

28

Fuel

CHAPTER 28
FUEL

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FUEL SYSTEM - INTRODUCTION

Purpose

The airplane fuel system has these primary purposes:

- Stores fuel for each engine
- Stores fuel for APU
- Supplies fuel to each engine
- Supplies fuel to the APU.

General

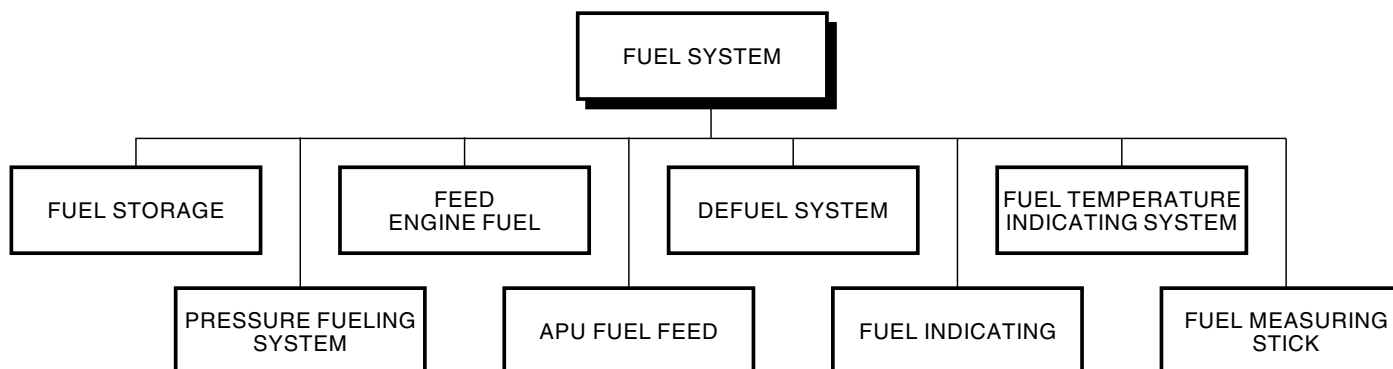
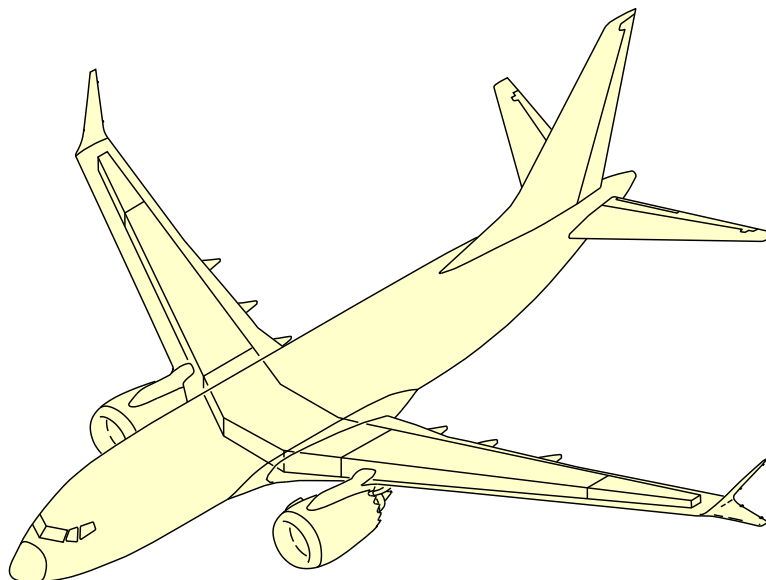
The fuel system has these subsystems:

- Fuel storage
- Pressure fueling
- Engine fuel feed
- APU fuel feed
- Defuel
- Fuel quantity indicating system
- Fuel temperature indicating system
- Fuel measuring stick.

Abbreviations and Acronyms

- APU - auxiliary power unit
- FQPU - fuel quantity processor unit
- FQIS - fuel quantity indicating system
- kg - kilograms
- lb - pounds
- MDS - MAX display system

FUEL SYSTEM - INTRODUCTION



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FUEL SYSTEM - INTRODUCTION

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FUEL SYSTEM - GENERAL DESCRIPTION

General

The airplane uses fuel tanks (two main tanks and one center tank) for fuel storage. Each fuel tank can independently supply the engines and Auxiliary Power Unit (APU). To add fuel to the fuel tanks, the pressure refueling station is on the right wing to supply the fuel to the fuel tanks. The refueling station also controls the fuel tank defueling and tank to tank fuel transfer.

Each main tank has two fuel boost pumps (fuel pumps) and the center tank also has two fuel boost pumps. The center fuel boost pumps supply fuel at a higher pressure than the fuel boost pumps for the main tanks. Because of the higher pressure, the center tank supplies fuel before the main tanks.

To prevent combustion of fumes, the Nitrogen Generation System (NGS) removes oxygen in the center tank.

The Fuel System Module (P5-2) controls the engine and APU fuel feed system. The fuel quantity shows on the MAX Display System (MDS) and at the refueling station.

BITE is available to maintenance personnel through the Control Display Unit (CDU).

Fuel Storage

The airplane has three fuel tanks and two surge tanks. The following fuel tanks are designed to store fuel:

- No. 1 main tank
- No. 2 main tank
- Center tank.

The No. 1 main tank is in the left wing and the No. 2 main tank is in the right wing. The center tank is located in the fuselage and the inboard section of each wing.

The surge tanks are located outboard of each main tank. They are designed to collect fuel overflow only.

Pressure Refueling System

The pressure fueling system fuels each fuel tank. The P15 Refuel Panel is on the right wing and the station controls fueling operations. There is no over wing fueling capability.

Engine Fuel Feed System

The engine fuel feed system supplies fuel from the fuel tanks to the engines. The fuel system module controls the engine fuel feed. The system also has fuel shutoff and crossfeed functions.

APU Fuel Feed

The APU fuel feed system supplies fuel to the APU. The APU usually receives fuel from the No. 1 main tank. Use the fuel boost pump switches to supply fuel to the APU from the other fuel tanks.

Defuel System

The defuel system can remove fuel from each fuel tank. The defuel system can also do a tank to tank fuel transfer on the ground.

Fuel Quantity Indicating System

The Fuel Quantity Indicating System (FQIS) measures the fuel weight in the main tanks and center tank. The MDS and refueling panel (P15) shows the fuel weight that the FQIS calculated.

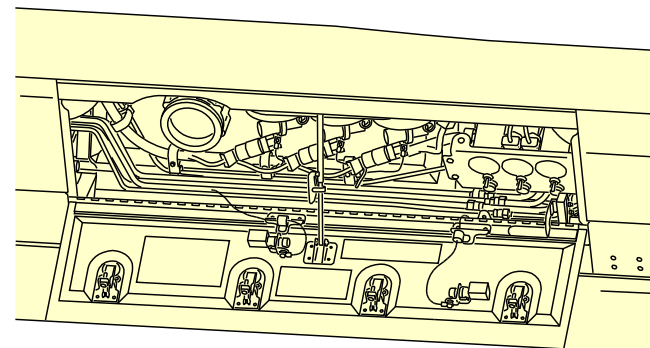
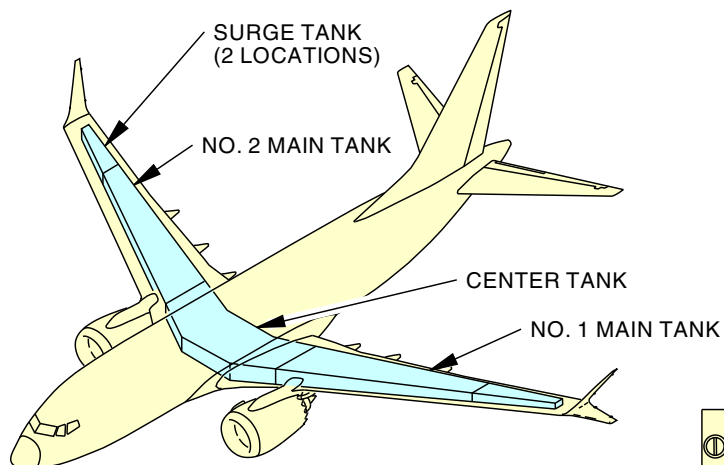
Total fuel weight shows in the Flight Management Computer System (FMCS) data on the CDU.

BITE data also shows on the CDU

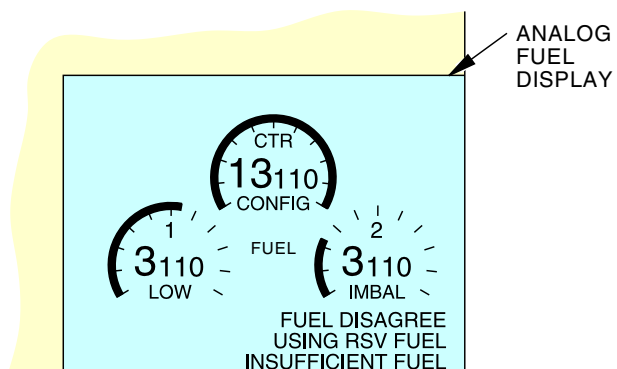
Fuel Temperature Indicating System

The No. 1 main tank is where the fuel temperature is measured. The measured fuel temperature shows on fuel temperature indicator on the fuel system module (P5).

FUEL SYSTEM - GENERAL DESCRIPTION

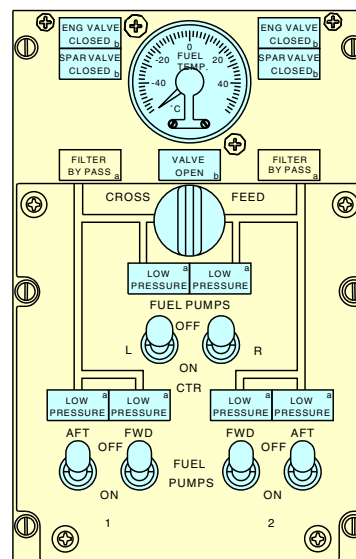


FUELING STATION

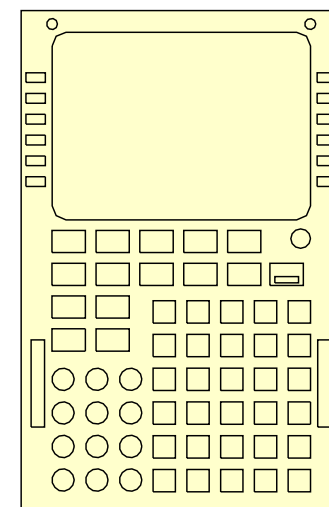


MAX DISPLAY SYSTEM (MDS)

NOTE: ALL INDICATIONS ARE DISPLAYED IN KILOGRAMS OR POUNDS.



FUEL SYSTEM MODULE, P5-2



FLIGHT MANAGEMENT COMPUTER (FMC)
CONTROL DISPLAY UNIT (CDU)

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FUEL SYSTEM - GENERAL DESCRIPTION



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FUEL STORAGE - GENERAL DESCRIPTION

Fuel Tank Arrangement

These are the fuel tanks:

- No. 1 main tank
- No. 2 main tank
- Center tank.

The surge tanks are found outboard of each main tank, they collect fuel overflow and fuel from the vent system. The fuel in the surge tank will drain back to the main tank when the airplane is at a constant velocity and cruise pitch angle. When the fuel level is high enough in the surge tank, fuel will drain out of the vent scoop.

Component Location

The No. 1 main tank is in the wing box in the left wing. The No. 2 main tank is in the wing box in the right wing. The center tank is in the fuselage and the left and right wing root.

Capacity

The estimated total usable fuel capacity is a nominal 6820 gal (25,817 l) (1273 gal (4819 l) for each of the #1 and #2 main tank, and 4274 gal (16,179 l) for the center tank.

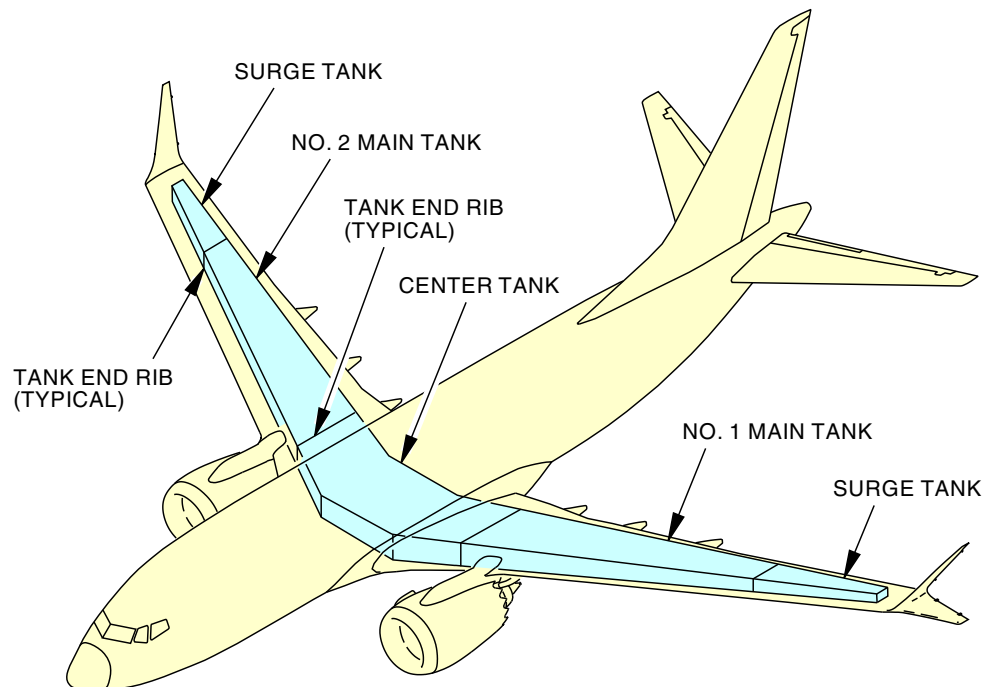
At 6.7 pound per us gallon (0.8029 Kilograms per liter) Fuel Density, the usable fuel capacity for each of #1 and #2 Main Tank, is 8529 lb (3869 kg).

At 6.7 pound per us gallon (0.8029 Kilograms per liter) Fuel Density, the usable fuel capacity for the center tank is 28,635 lb (12,990 kg).

The capacity of each surge tank is 235 lb (107 kg).

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FUEL STORAGE - GENERAL DESCRIPTION



FUEL TANK CAPACITY		
	LB	KGS
NO. 1 MAIN TANK	8,529	3,869
NO. 2 MAIN TANK	8,529	3,869
CENTER TANK	28,635	12,990
TOTAL	45,694	20,728

NOTE:

FUEL DENSITY 6.7 POUNDS PER US GALLON (0.8029 KILOGRAMS PER LITER)

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FUEL STORAGE - GENERAL DESCRIPTION

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**FUEL STORAGE - FUEL TANK ACCESS****General**

Wing fuel tank access panels permit entry in each fuel and surge tank. The wing fuel tank access panels are on the bottom wing skin. One center tank access panel permits entry in the center tank through the fuselage. This panel is in the left air conditioning compartment.

The wing ribs divide the fuel tanks to bays. Wing fuel tank access panels are between the wing ribs. Access across wing ribs to adjacent bays is through cutouts.

Wing rib 8, in the No. 1 and No. 2 main tank, has check valves. The check valves let fuel flow inboard but do not let fuel flow outboard.

Tank end ribs close the ends of each fuel tank. There is no fuel flow through the tank end ribs.

Fuel Tank Locations

The side-of-body rib is rib 1. The No. 1 main tank is between rib 5 and rib 22. The location of the No. 2 main tank is the same.

The center tank is between rib 5 in the left wing and rib 5 in the right wing.

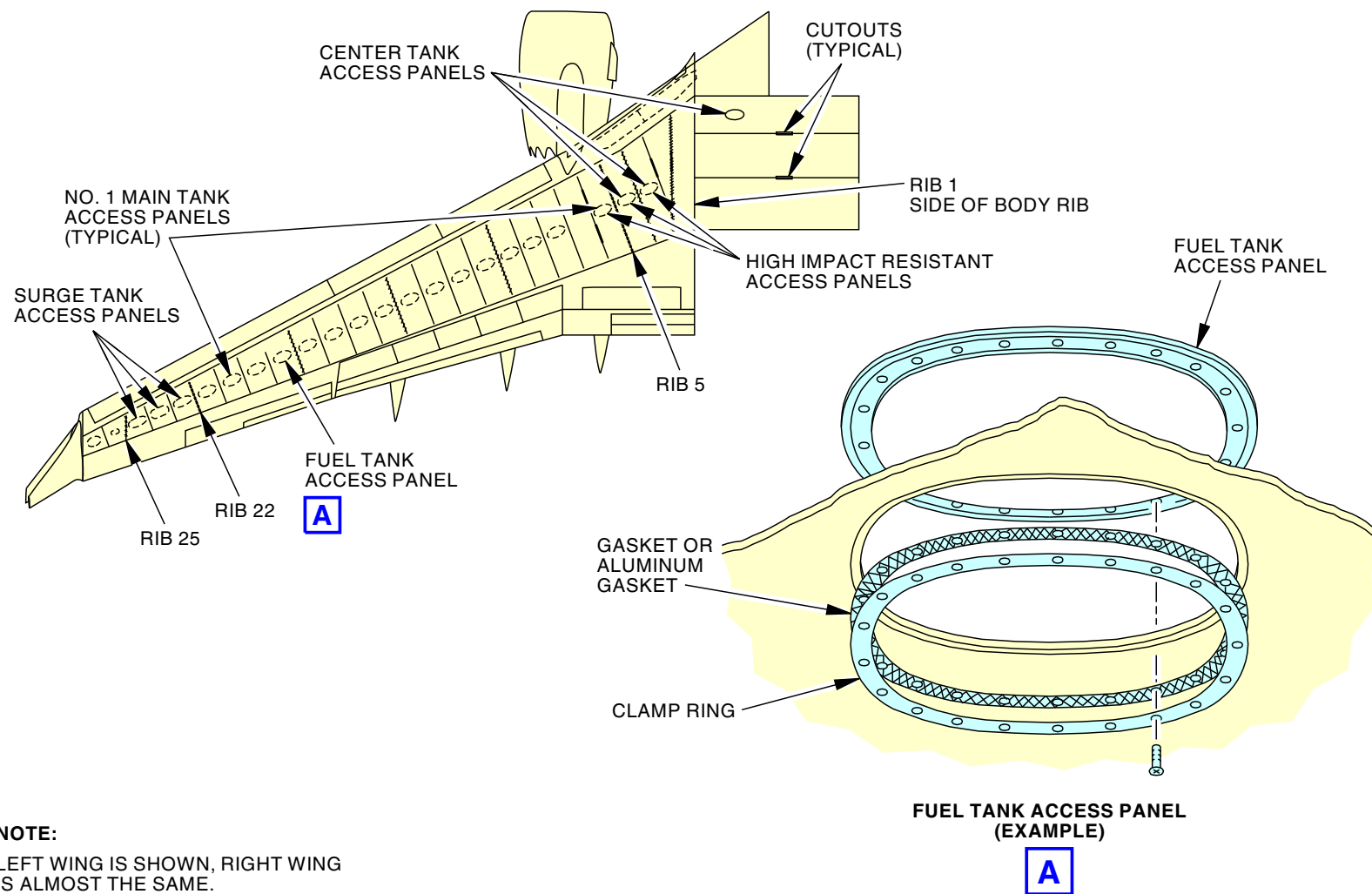
The surge tank for the No. 1 and No. 2 main tank is between rib 22 and rib 25.

Fuel Tank Access Panels

The fuel tank access panels attach to the bottom wing skin with a clamp ring. An aluminum gasket supplies a proper fit and an electrostatic bond.

The impact resistant access panels for the fuel tanks are in areas that are subject to impact damage. The three inboard fuel tank access panels, on each wing, are impact resistant panels.

FUEL STORAGE - FUEL TANK ACCESS



NOTE:

LEFT WING IS SHOWN, RIGHT WING IS ALMOST THE SAME.

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FUEL STORAGE - FUEL TANK ACCESS

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FUEL STORAGE - SUMP DRAIN VALVES

General

The sump drain valve lets fuel, water, and other contamination drain from the fuel tank. Also, fuel can be drained between the fuel suction tube and the sump valve when the fuel tanks are defueled.

The sump drain valves are attached to the bottom wing skin or the bottom of the fuselage. The sump drain valves are at the lowest point in the fuel tanks and surge tanks. Each sump drain valve is a 0.5 in. (1.3 cm) diameter poppet type valve.

The sump drain valve in the center tank attaches to the lower wing skin panel.

Component Location

The sump drain valve for No. 1 and No. 2 main tank is outboard of rib 5.

The sump drain valve for the center tank is near the center of the center tank. Access to the sump drain valve from the access door on the lower fuselage skin. The access door is between the two air conditioning access doors.

The sump drain valve for the surge tanks is outboard of rib 22. The sump drain valve is on the bottom wing skin.

Operation - Main Tank

The sump drain valves are spring loaded closed, and the primary poppet can be removed without defueling the fuel tank. To lock the sump drain valve to the closed position, align the poppet slot with the lines on the valve cap. To unlock the sump drain valve, turn the poppet slot 90° with a flat blade screw driver.

When unlocked, open the sump drain valve by pushing up the poppet with a screwdriver or drain tool probe. To drain large quantities of fuel, remove the primary poppet and then install a special tool into the valve. This special tool opens the secondary poppet.

Operation - Center Tank and Surge Tank

To open the sump drain valve, push up on the center of the valve. An internal spring closes the sump drain valve.

To drain fluid from the center tank, open the access door and pull down on the rod. An internal spring closes the sump drain valve.

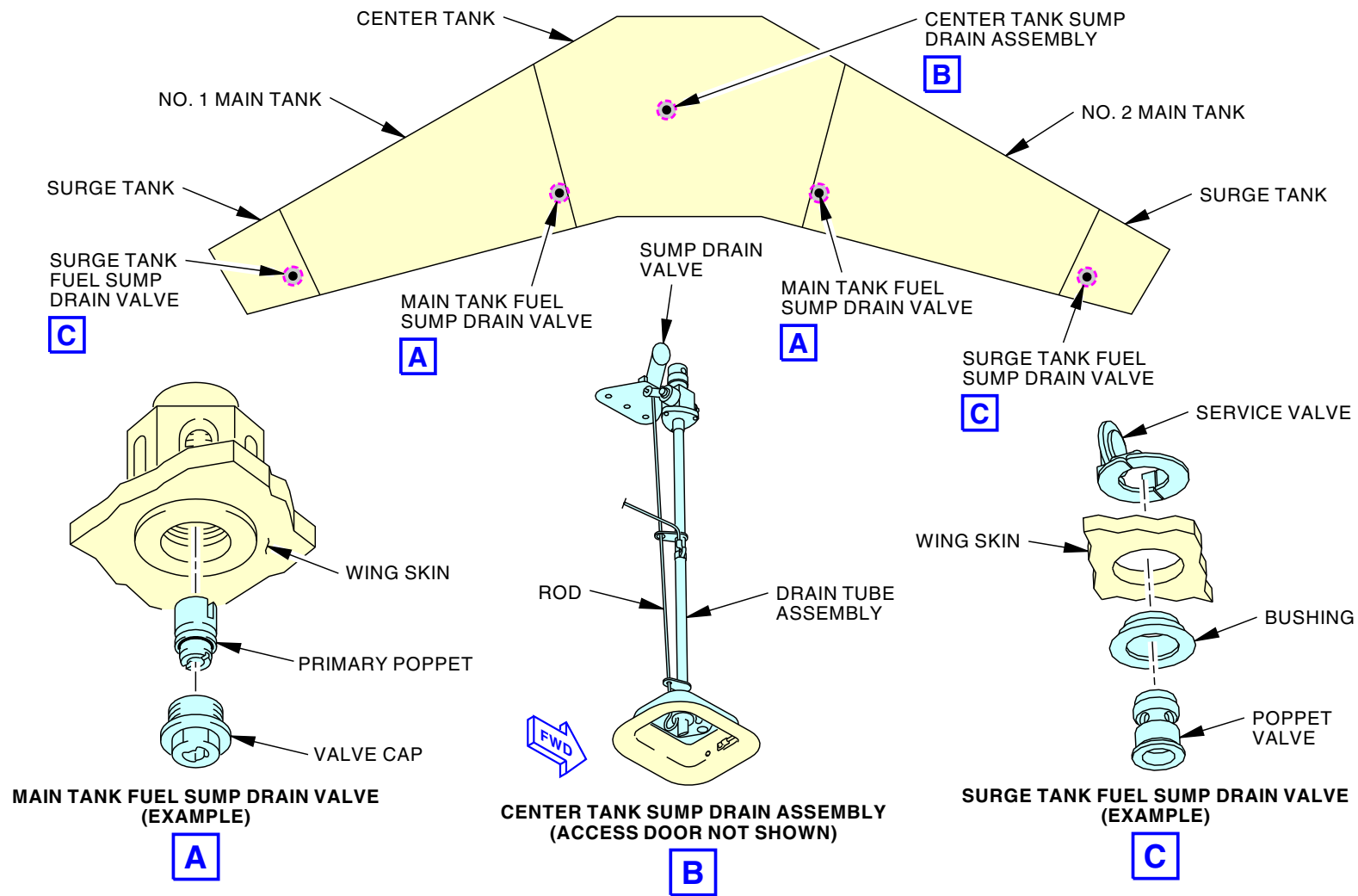
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FUEL STORAGE - SUMP DRAIN VALVES



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FUEL STORAGE - SUMP DRAIN VALVES

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FUEL STORAGE - FUEL VENT SYSTEM

General

The fuel vent system keeps the pressure in the fuel tanks near the ambient pressure. This prevents a large a pressure difference that can cause damage to the wing structure.

Drains let fuel in the vent system back to the fuel tanks.

Flame arrestors make sure that too much heat does not go into the fuel vent system. A clogged flame arrestor causes the pressure relief valve in the surge tank to open. When open, the pressure relief valve becomes a regular vent for the fuel vent system.

Component Locations

Stringers and the upper wing skin make the vent channels. The vent channels have drain float valves in the center tank.

Vent tubes attach to vent channels. Each vent tube has a drain float valve.

A fuel vent float valve is on the outboard fuel tank end rib in the No. 1 and No. 2 main tank.

A surge tank check valve is on the outboard fuel tank end rib in the No. 1 and No. 2 main tank.

The vent scoop and pressure relief valve are on an access door in each surge tank.

Functional Description

Vent channels and vent tubes equalize the pressure between the fuel tanks and the surge tanks when the airplane is in a climb attitude. The surge tanks are open to the atmosphere through the vent scoop.

The fuel vent float valves equalize the pressure between main tanks and the surge tanks when the airplane is in a cruise or descent attitude.

The drain float valves in the vent tubes and the vent channels let fuel in the vent system. The fuel in the vent system drains into the tank when the fuel level is lower than the valve.

The surge tank drain check valve let fuel in the surge tanks to flow into the main tanks. The surge tank drain check valve also prevents fuel flow from the main tanks to the surge tanks.

The pressure relief valve prevents damage to the wing structure when there is too much positive or negative pressure in the fuel tanks. The pressure relief valve is usually closed. While the pressure relief valve is closed, the bottom surface of the wing is smooth. When there is too much positive or negative pressure, the pressure relief valve opens. When it is open, part of the pressure relief valve is in the fuel tank. After it opens, the pressure relief valve stays in the open position. In the open position, the pressure relief valve is a vent in the surge tank. Pull the reset handle to move the pressure relief valve to the closed position.

For normal operations, make sure that the pressure relief valve is closed. An open pressure relief valve is a symptom of a problem in the fuel vent system.

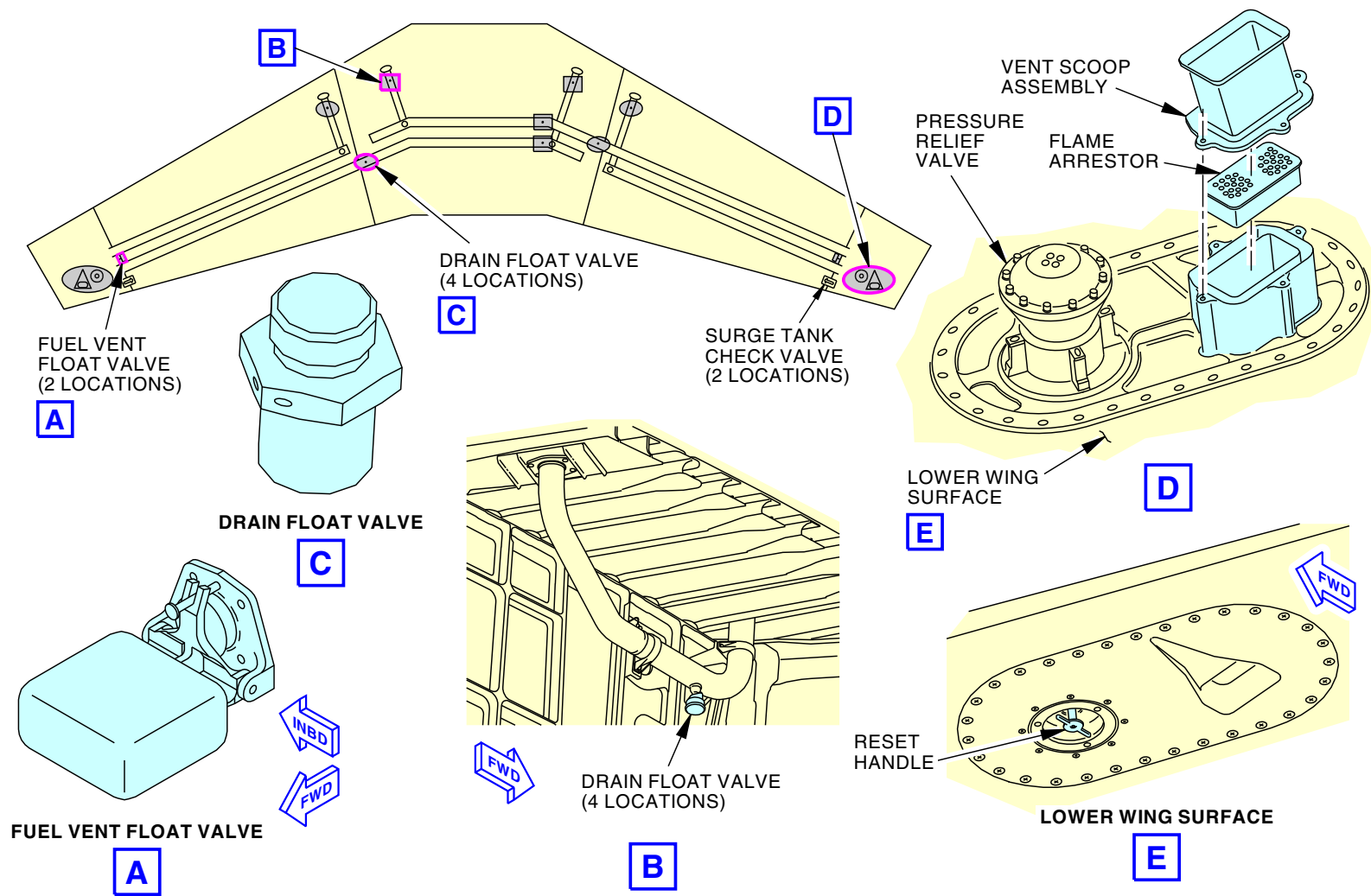
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FUEL STORAGE - FUEL VENT SYSTEM



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FUEL STORAGE - FUEL VENT SYSTEM



FUEL STORAGE - CENTER TANK SCAVENGE SYSTEM

General

The fuel scavenge system in the center tank increases the quantity of fuel the airplane can use.

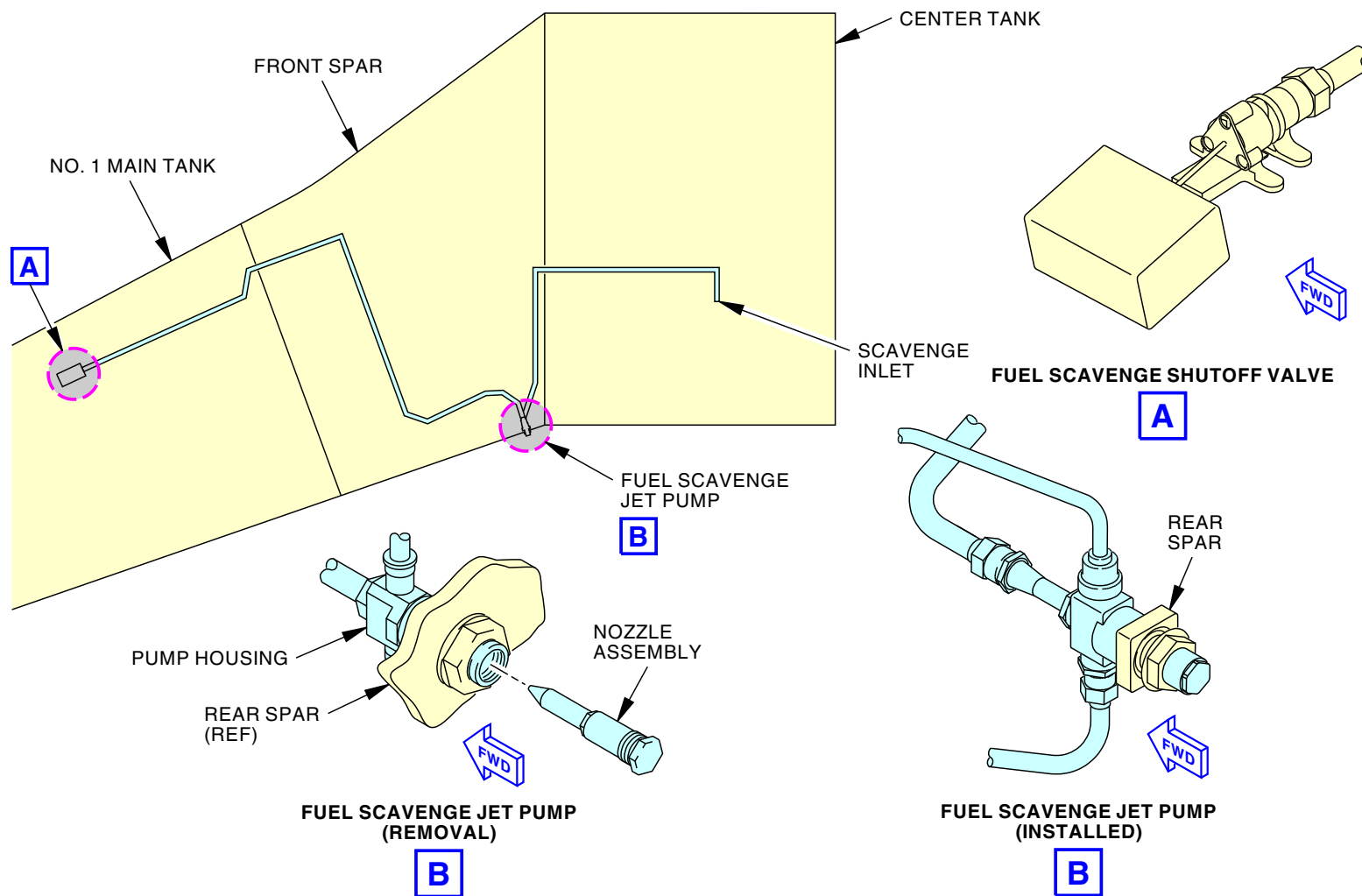
Functional Description

The forward fuel boost pumps for the No. 1 main tank supply motive flow to a jet pump. The jet pump removes fuel from the center tank and moves it to the No. 1 main tank. The jet pump has no parts that move and is on the left rear spar. A fuel scavenge shutoff valve controls fuel sent to the No. 1 main tank. When the fuel level in the No. 1 main tank decreases to 4,487 lbs (1,990 kgs), the float valve opens.

The minimum rate of fuel movement for the fuel scavenge system is 220 lbs/hour (100 kgs/hour). The rate of fuel movement for the fuel scavenge system is usually between 220 lbs/hour (100 kgs/hour) and 450 lbs/hour (200 kgs/hour).

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FUEL STORAGE - CENTER TANK SCAVENGE SYSTEM



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FUEL STORAGE - CENTER TANK SCAVENGE SYSTEM

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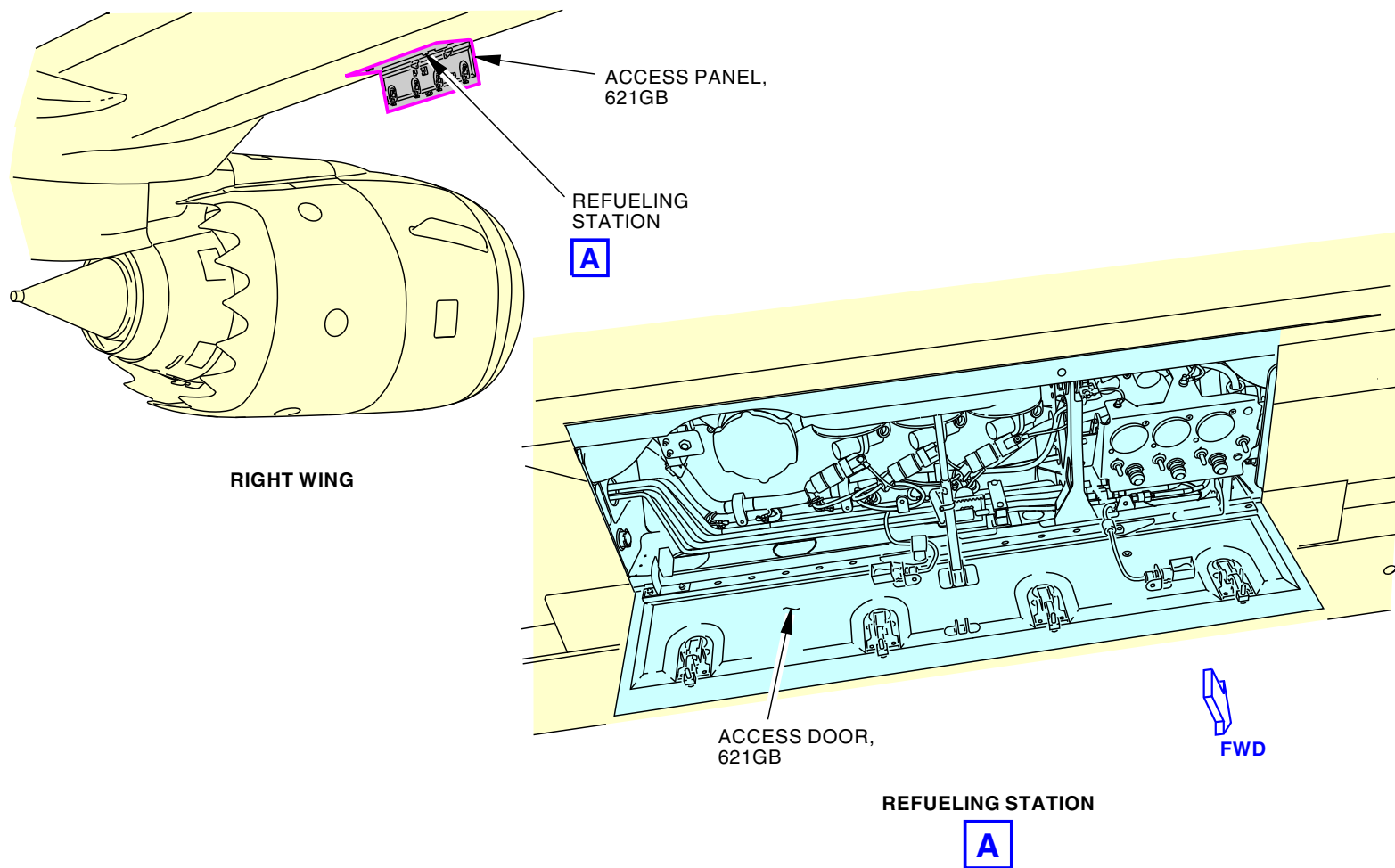
PRESSURE FUELING SYSTEM - INTRODUCTION

General

The pressure fueling system lets you refuel all fuel tanks. The fueling pressure system is also used when transferring fuel from tank-to-tank.

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PRESSURE FUELING SYSTEM - INTRODUCTION



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PRESSURE FUELING SYSTEM - INTRODUCTION

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PRESSURE FUELING SYSTEM - GENERAL DESCRIPTION

General

All fuel tanks fill from the refueling station at the right wing. The fueling station has these components:

- Refuel panel, P15
- Fueling manifold
- Fueling receptacle
- Fueling check valve
- Fueling body/elbow assembly
- Fueling shutoff valves (3).

The outlet end of the fueling manifold, for the No. 1 main tank, has a drain float valve and a check valve. The drain float valve lets fuel that remains in the refuel manifold drain in the No. 1 main tank when the fuel level decreases. The check valve prevents fuel transfer from the No. 1 main tank when the fueling manifold is damaged.

Control

The refueling station permits automatic and manual control of the fueling shutoff valves. The fueling station receives 28v dc hot battery bus power through the refueling power control relay. The relay energizes when 621 GB access panel opens. The relay power comes from one of these sources:

- Battery Bus
- DC Bus 1
- Bus power control unit (BPCU) internal transformer rectifier.

When the fueling indication test switch is set to FUEL DOOR SWITCH BYPASS on the P15 Refuel Panel, this supplies an alternative ground for the refueling power control relay.

The airplane can be refueled with one of these electrical power sources:

- External power on electrical system buses
- External power connected to the airplane, but not on electrical system buses

- APU generator
- Battery power (battery switch must be on).

The preselect switch on the refuel quantity indicator (P15 Refuel Panel) is used to select the total fuel to add into the fuel tank. The solenoid on the fueling shutoff valve energizes when the fueling shutoff valve switch is set to the OPEN position on the P15 Refuel Panel. The fueling shutoff valve automatically opens when there is fuel pressure. The fuel quantity indicator automatically removes power to the fueling shutoff valve when fuel gets to the selected fuel quantity. To manually stop refueling, set the fueling shutoff valve switch to the CLOSED position.

To open a failed solenoid, each fueling shutoff valve has a manual override plunger.

Indication

Three valve position lights show that there is power to the fueling shutoff valves. The light does not show that the fueling shutoff valve is open. These lights are press-to-test. Three fueling indicators show fuel quantity in each fuel tank.

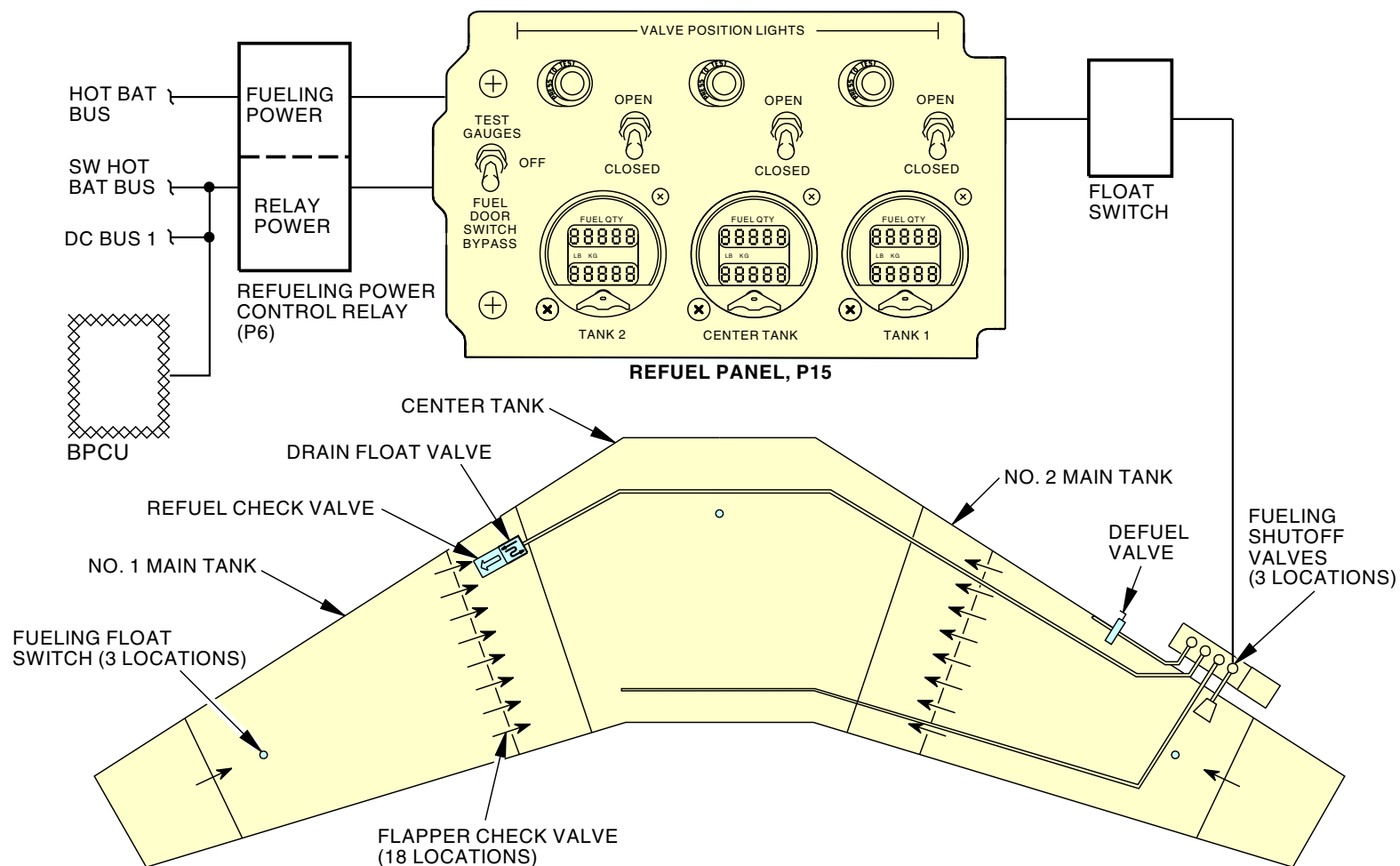
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PRESSURE FUELING SYSTEM - GENERAL DESCRIPTION



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PRESSURE FUELING SYSTEM - GENERAL DESCRIPTION

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PRESSURE FUELING SYSTEM - COMPONENT LOCATION

General

These pressure fueling system components are at the refueling station:

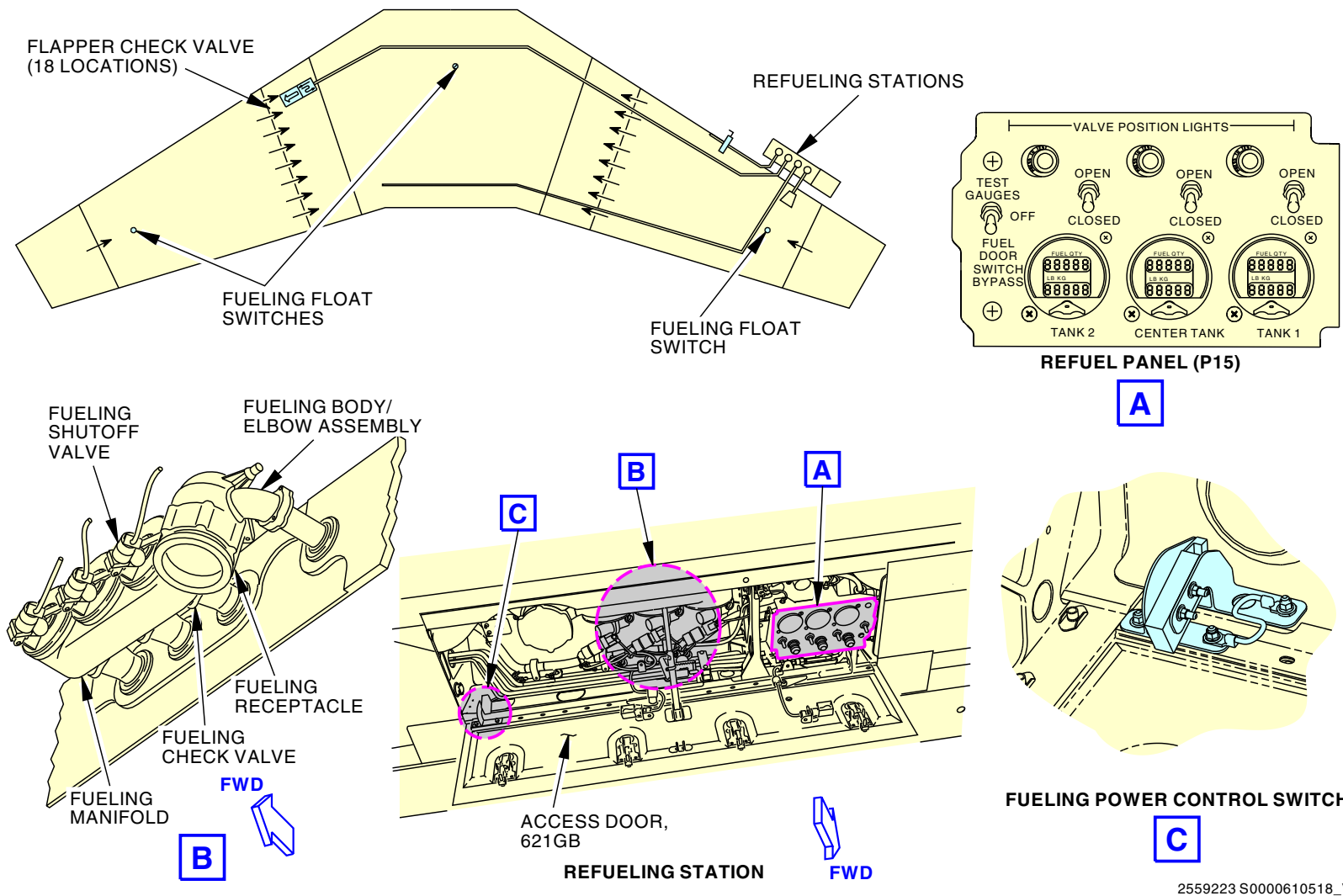
- Fueling receptacle
- Fueling manifold
- Fueling check valve
- Fueling body/elbow assembly
- Fueling shutoff valve
- Refuel Panel, P15.

A fueling float switch is in each tank.

There are 18 flapper check valves.

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PRESSURE FUELING SYSTEM - COMPONENT LOCATION



2559223 S0000610518_V1

PRESSURE FUELING SYSTEM - COMPONENT LOCATION



PRESSURE FUELING SYSTEM - P15 REFUEL PANEL

General

The P15 Refuel Panel has these components:

- Three refuel valve lights
- Fueling indication test switch
- Three fueling shutoff valve switches
- Three fuel quantity indicators

Refuel Valve Lights

The blue refuel valve lights come on when the fueling shutoff valve solenoids have power.

Fueling Indication Test Switch

The fueling indication test switch is a three-position switch. The switch is spring loaded to the center (neutral) position. When the switch is in the FUEL DOOR SWITCH BYPASS position, the refueling power control relay energizes. The normal ground for this relay is through the fueling power control switch. This relay controls power for fueling.

When the switch is in the TEST GAUGES position, the fuel quantity indicators do a display test. Fuel quantity in the flight compartment does not change for this test.

The FUEL DOOR SWITCH BYPASS position and the TEST GAUGES position are momentary positions.

Fueling Shutoff Valve Switches

The fueling shutoff valve switches are two-position switches. The fueling shutoff valve solenoid energizes when you put the switch to the OPEN position and power is available. The valve opens when fuel pressure is available at the fueling manifold. In the CLOSED position, the fueling valve solenoid de-energizes and the valve closes.

Fuel Quantity Indicators

The fuel quantity indicators are amber LED displays and operate on 28v dc power and the ARINC bus 1.

The fuel quantity indicator shows the current fuel quantity for the applicable fuel tank. Fuel quantity and preselect indicator display shows in pounds or kilograms.

The preselect switch lets you select a total fuel tank quantity at which fueling stops. During fueling, when the fuel quantity in the fuel tank equals the preselect quantity, the fueling valves close.

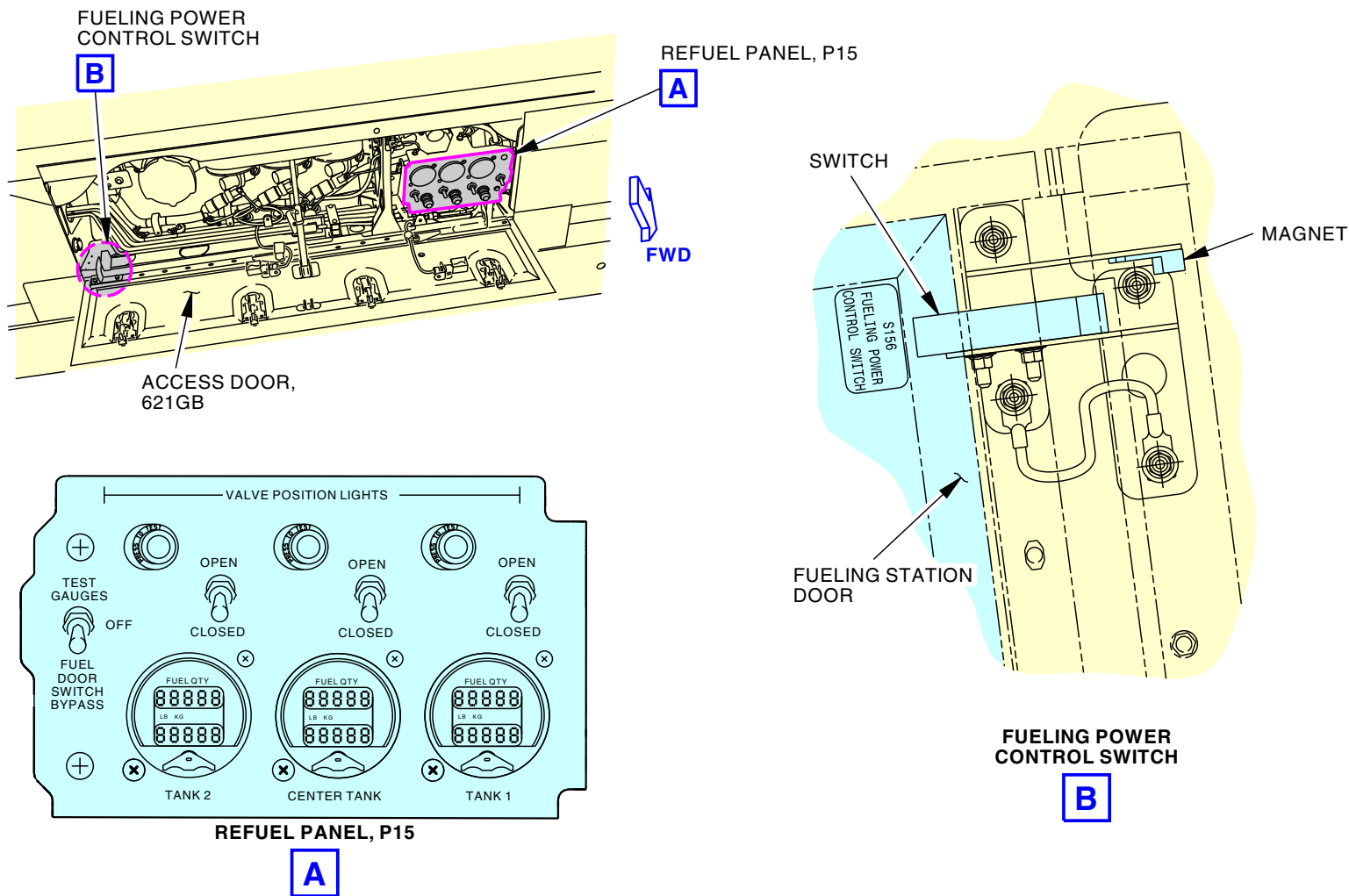
The fuel quantity indicators have a tank overfill indication. The fuel quantity indicators will blink on and off at a one second intervals when the quantity is more than the rated capacity of that fuel tank. The flight compartment fuel quantity indication does not blink.

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PRESSURE FUELING SYSTEM - P15 REFUEL PANEL



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PRESSURE FUELING SYSTEM - P15 REFUEL PANEL

28-21-00

**PRESSURE FUELING SYSTEM - FUELING MANIFOLD****General**

These components are part of the fueling manifold assembly:

- Fueling receptacle (1x)
- Fueling manifold (1x)
- Fueling shutoff valves (3x)
- Fueling check valves (3x)
- Refueling port.

Fueling Receptacle

The fueling receptacle supplies a connection for the fueling hose.

Fueling Manifold

The fueling manifold distributes fuel from the fueling receptacle to the fuel tanks.

Fueling Shutoff Valves

The fueling shutoff valves control fuel flow to the fuel tanks. A solenoid controls the valve while fuel pressure operates the valve. A manual override plunger on each valve permits manual operation.

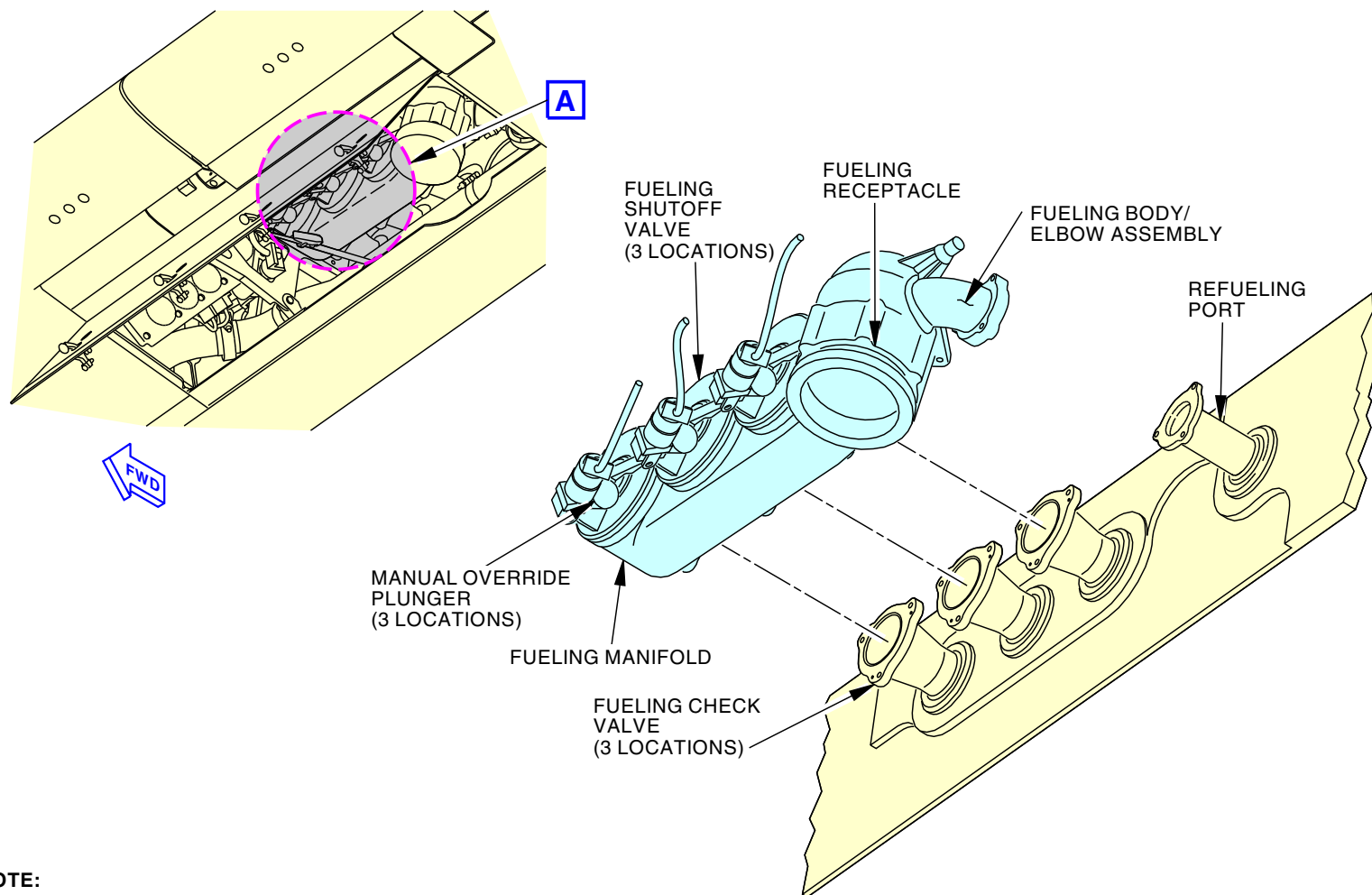
Fueling Check Valves

The fueling check valves let the fueling manifold be replaced without defueling each fuel tank.

Refueling Port

The refueling port lets tank-to-tank transfer or defueling to occur.

PRESSURE FUELING SYSTEM - FUELING MANIFOLD



NOTE:
VIEW IS FOR COMPONENT LOCATION ONLY.

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PRESSURE FUELING SYSTEM - FUELING MANIFOLD

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**PRESSURE FUELING SYSTEM - FUELING FLOAT SWITCHES****General**

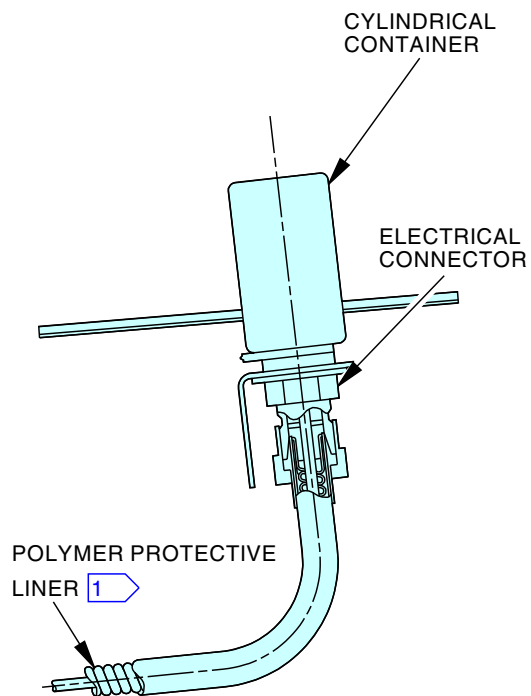
The fueling float switches prevent the fuel tanks from over-fueling.

The fueling float switches remove power to the fueling shutoff valves when the fuel level in the fuel tank is full.

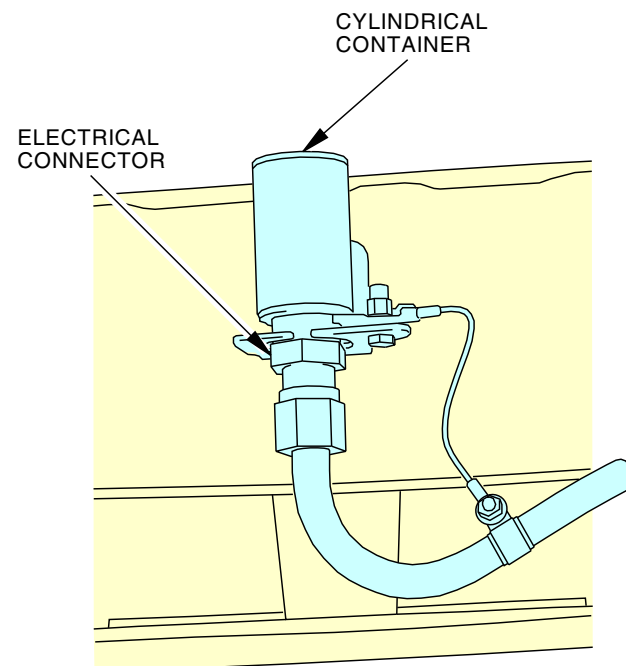
The fueling float switches have a float that is in a cylindrical container. When the fuel tank is not full, the float switch lets power go to the fueling shutoff valve solenoid. When the fuel tank is full, the fueling float switch removes power to the fueling shutoff valve solenoid.

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PRESSURE FUELING SYSTEM - FUELING FLOAT SWITCHES



CENTER TANK FUELING FLOAT SWITCH



**NO. 1 AND NO. 2 MAIN TANK
FUELING FLOAT SWITCH**

1 POLYMER PROTECTIVE LINER IN ALL FLOAT SWITCH CONDUIT

2369196 S00061519022_V1

PRESSURE FUELING SYSTEM - FUELING FLOAT SWITCHES

28-21-00

**PRESSURE FUELING SYSTEM - FUNCTIONAL DESCRIPTION - POWER AND CONTROL****General**

Power for the pressure fueling system comes from the 28v dc hot battery bus. When the refueling station receives power, the outboard fueling panel flood light and the outboard fueling nozzle flood light come on, and the P15 Refuel Panel receives power.

Hot Battery Bus

The refueling power control relay energizes when the fueling panel door opens. With the relay energized, the P15 Fueling Panel receives power from the hot battery bus.

Fueling Shutoff Valve - Open Control

The fueling shutoff valve opens when all of these conditions are true:

- There is power to the P15 Refueling Panel
- Fueling shutoff valve switch is in the OPEN position
- Fueling float switch is in the not full position
- The fueling shutoff valve solenoid energizes
- Fuel pressure is at the fueling valve.

Refueling Valve Light - Light Is On

The refueling valve light comes on when the fueling shutoff valve solenoid has power. The light does not show that the fueling shutoff valve is open.

Fueling Shutoff Valve - Closed Control

The fueling shutoff valve closes when one of these conditions are true:

- The P15 Refueling Panel does not have power
- Fueling shutoff valve switch is in the CLOSED position
- Quantity of fuel in the fuel tank equals the selected fuel quantity
- Fueling float switch is in the full position
- No fuel pressure at the fueling shutoff valve.

Refueling Valve Light - Light is Off

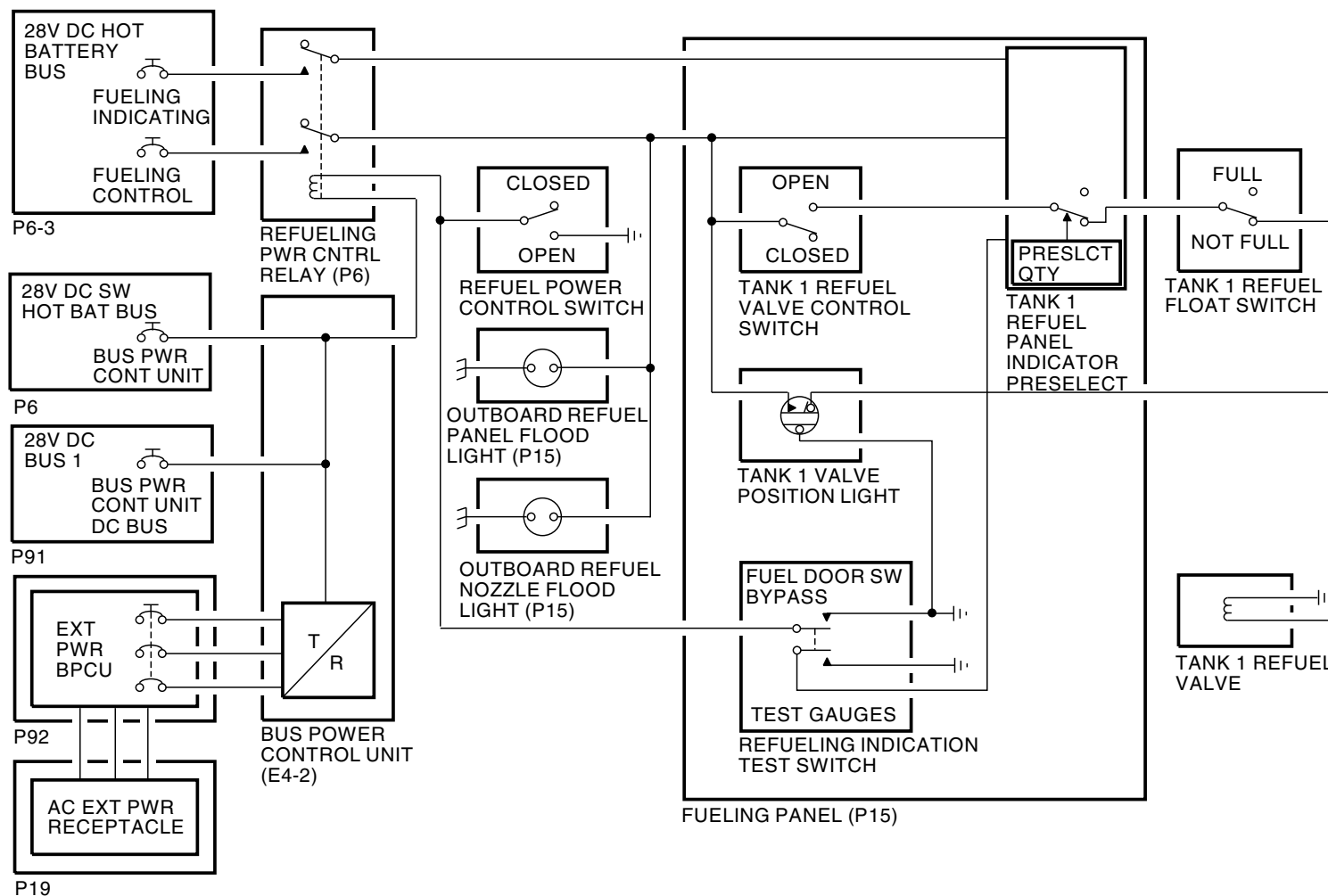
The refueling valve light goes off when there is no power to the fueling shutoff valve solenoid.

Fuel Indication Test Switch

When the switch is in the FUEL DOOR SWITCH BYPASS position, the P15 Refuel Panel receives power from the hot battery bus.

When the switch is in the TEST GAUGES position, it tests the refuel quantity indicators.

PRESSURE FUELING SYSTEM - FUNCTIONAL DESCRIPTION - POWER AND CONTROL



2559227 S0000610527_V1

PRESSURE FUELING SYSTEM - FUNCTIONAL DESCRIPTION - POWER AND CONTROL

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PRESSURE FUELING SYSTEM - OPERATION

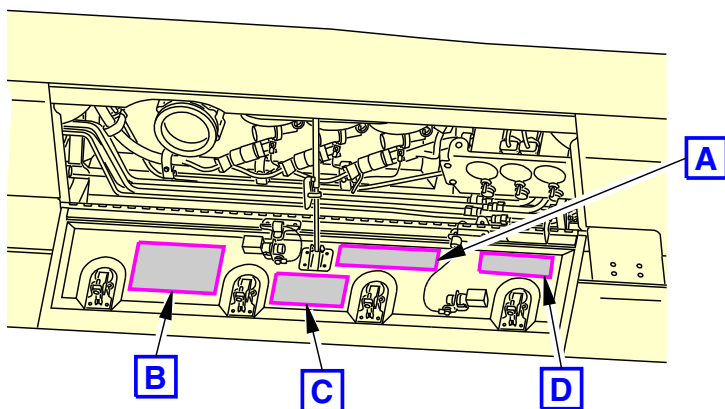
General

Fueling placards, with instructions for fueling, are on the fueling station door.
Use these placards when fueling the aircraft.

The fueling station receives power when the fueling station door opens.

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PRESSURE FUELING SYSTEM - OPERATION



USABLE FUEL CAPACITY		
TANK NO. 1	CENTER TANK	TANK NO. 2
XX U.S. GALLONS	XX U.S. GALLONS	XX U.S. GALLONS
XX LITERS	XX LITERS	XX LITERS

(EXAMPLE)

A

- FUELING INSTRUCTIONS**
1. INSTALL GROUNDING JACKS AND COUPLE FUELING NOZZLE.
 2. TOGGLE SWITCH TO "TEST GAGES" POSITION-VERIFY ALL UPPER AND LOWER DISPLAYS READ 88888.
 3. PRESS BLUE "VALVE POSITION LIGHTS"-VERIFY LIGHTS ILLUMINATE.
 4. OPEN CONTROL SWITCHES FOR TANKS TO BE SERVICED. BEGIN FUEL FLOW.
CAUTION-FLASHING UPPER GAGE INDICATES MAXIMUM TANK CAPACITY HAS BEEN EXCEEDED. STOP FUELING AT TRUCK.
 5. CLOSE CONTROL SWITCHES WHEN FUELING STOPS AT FULL TANK OR DESIRED QUANTITY IS REACHED.
 6. UNCOUPLE NOZZLE AND REMOVE JACKS.
 7. VERIFY ALL CONTROL SWITCHES ARE RETURNED TO THE OFF POSITION AND BLUE "VALVE POSITION LIGHTS" ARE OFF.
- NOTE:**
BLUE LIGHT INDICATES VALVE ENERGIZED OPEN FOR FUELING OPERATION.

(EXAMPLE)

B

CAUTION

DO NOT EXCEED 55 PSIG/379 kPa FUEL PRESSURE.
MINIMUM DEFUEL PRESSURE IS -5 PSIG/-35 kPa.
SERVICE THIS AIRPLANE WITH
JET FUEL SPEC. GE D50TF2 EXCEPT:
DO NOT USE WIDE CUT FUELS
(CLASS B PER GE D50TF2, JET B OR JP-4)

(EXAMPLE)

C

**DO NOT OPERATE ENGINE WITH
KATHON™ FP 1.5 BIOCIDIC FUEL ADDITIVE**

(EXAMPLE)

D

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PRESSURE FUELING SYSTEM - OPERATION

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ENGINE FUEL FEED - INTRODUCTION

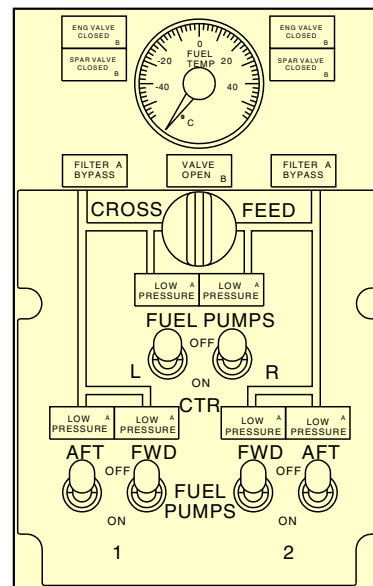
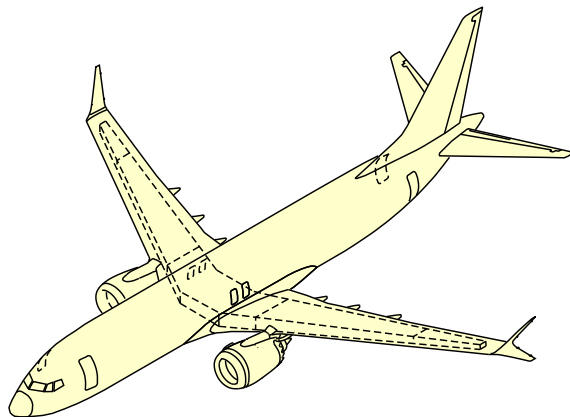
General

The engine fuel feed system supplies fuel to the engines from main tank 1, main tank 2, and the center tank.

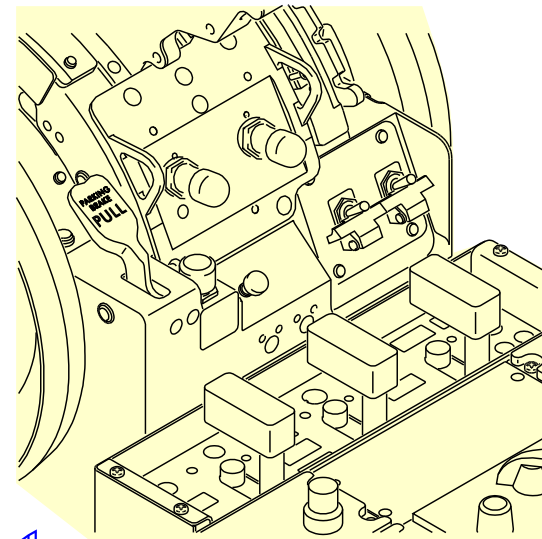
You operate the engine fuel feed system from the fuel control panel (P5-2) and the engine start levers (P8).

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ENGINE FUEL FEED - INTRODUCTION



FUEL CONTROL PANEL



ENGINE START LEVERS

ENGINE FUEL FEED - INTRODUCTION

2369199 S00061519030_V2



ENGINE FUEL FEED - GENERAL DESCRIPTION

General

The engine fuel feed system controls and supplies fuel to the engines. It uses these inputs:

- Fuel system panel (P5-2)
- Engine start levers
- Engine fire switches.

The engine fuel feed system uses these components to supply fuel to the engines:

- Center tank boost pumps
- Forward boost pumps
- Aft boost pumps
- Bypass valve
- Crossfeed valve
- Engine fuel spar valve.

Center Tank Boost Pump Control

A switch, on the P5-2 fuel system panel, controls each center tank boost pump. The switches control electrical power to the pumps.

Center Tank Boost Pump Indication

A LOW PRESSURE light comes on when the center tank boost pump pressure is low and the center tank boost pump switch is in the ON position.

There is a 10 second delay after the fuel LOW PRESSURE light comes on, before the master caution light comes on.

Fuel Boost Pump

A switch, on the P5-2 fuel system panel, controls each forward and aft boost pump for main tank No. 1 and main tank No. 2. The switches control power to the pumps.

Fuel Boost Pump Indication

A LOW PRESSURE light comes on when the fuel boost pump pressure is low or when the boost pump switch is in the OFF position.

Bypass Valve

A bypass valve supplies a secondary fuel flow path to the engines. The bypass valves operate automatically.

Engine Fuel Spar Valve

The engine fuel spar valves control fuel flow to the engines. The engine start levers and the engine fire switches control the engine fuel spar valves.

Fuel Spar Valve Battery

The engine fuel spar valve battery makes sure that the engine fuel feed system always has power to close the engine fuel spar valve.

Engine Fuel SPAR Valve Indication

A blue SPAR VALVE CLOSED light shows valve position.

Crossfeed Valve

The crossfeed valve permits a single fuel tank to supply fuel to both engines. A switch, on the P5-2 fuel system panel, controls the crossfeed valve.

Crossfeed Valve Indication

A blue VALVE OPEN light shows valve position.

Water Scavenge Ejector Pumps

The water scavenge jet pumps remove water from the low points of each tank to prevent corrosion. The center tank, main tank No. 1, and main tank No. 2 boost pumps control the operation of the water scavenge ejector pumps.

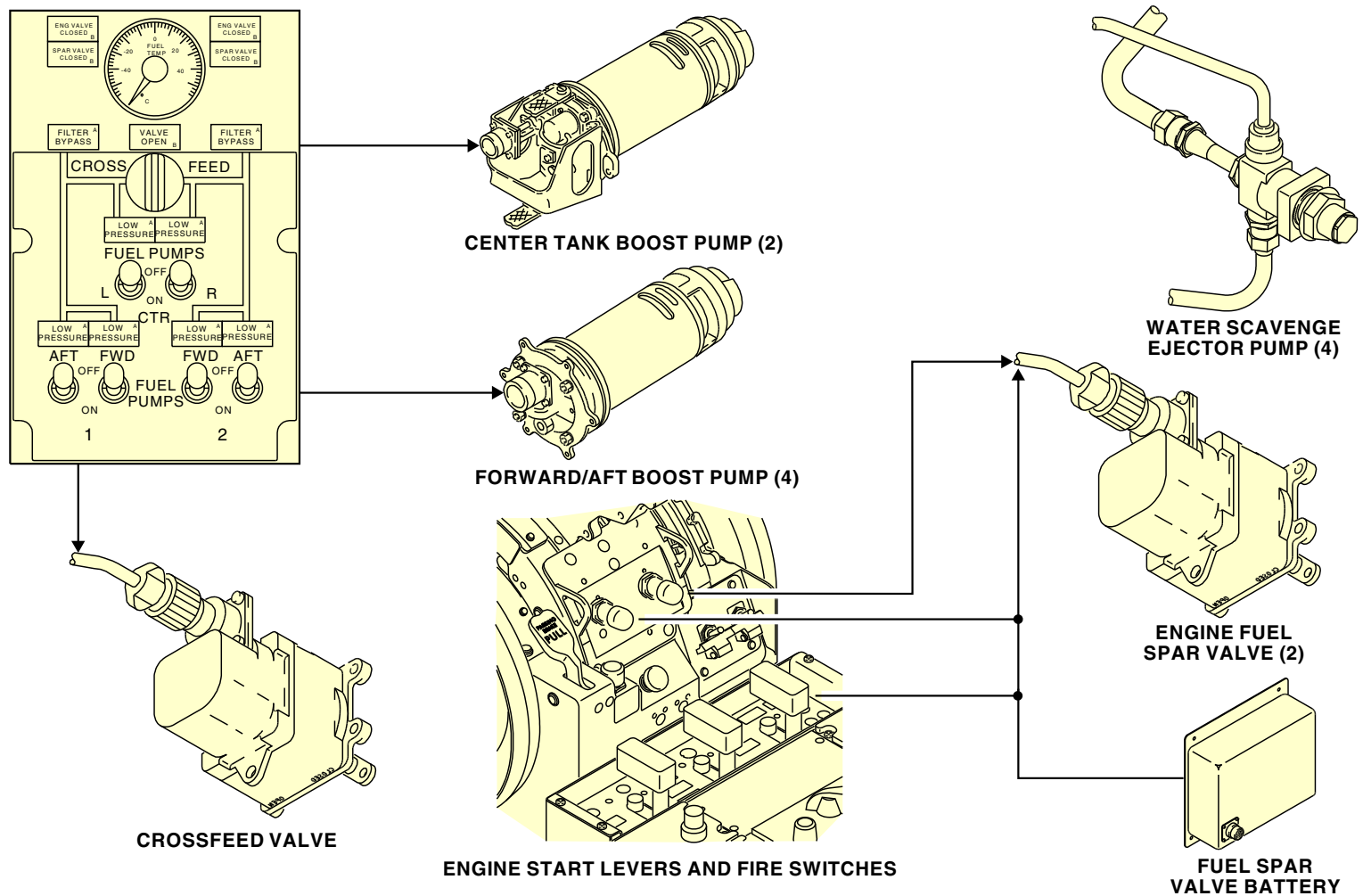
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ENGINE FUEL FEED - GENERAL DESCRIPTION



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ENGINE FUEL FEED - GENERAL DESCRIPTION

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**ENGINE FUEL FEED - COMPONENT LOCATION****General**

The engine fuel feed system has these components:

- Center tank boost pump (2)
- Forward and aft boost pump (4)
- Crossfeed valve
- Engine fuel spar valve (2)
- Bypass valve (2)
- Water scavenge ejector pump (4).

Center Tank Boost Pumps

There are two center tank boost pumps in the center tank. They are installed on the rear spar. Access to the center tank boost pumps is through the wheel wells.

Forward and Aft Boost Pumps

Each main tank has a forward and aft boost pump. The forward and aft boost pumps are on the rear spar. Access to the boost pumps are through the wheel wells.

Crossfeed Valve

The crossfeed valve is on the right side of the center tank on the rear spar. Access to the crossfeed valve is through the right wheel well.

Engine Fuel Spar Valves

There is one engine fuel spar valve for each engine. The engine fuel spar valves are on the front spar outboard of each strut.

Bypass Valves

There is one bypass valve in main tank No. 1 and No. 2. The bypass valve connects to the fuel feed manifold.

The bypass valves are inside the main fuel tanks. Access is through the fuel tank access panels under each wing.

Water Scavenge Ejector Pumps

There is one water scavenge ejector pump in main tank No. 1 and No. 2. There are two water scavenge ejector pumps in the center tank. All of the water scavenge ejector pumps are on the rear spar.

Fuel Shutoff Valve Battery

The fuel shutoff valve battery is in the P6 panel.

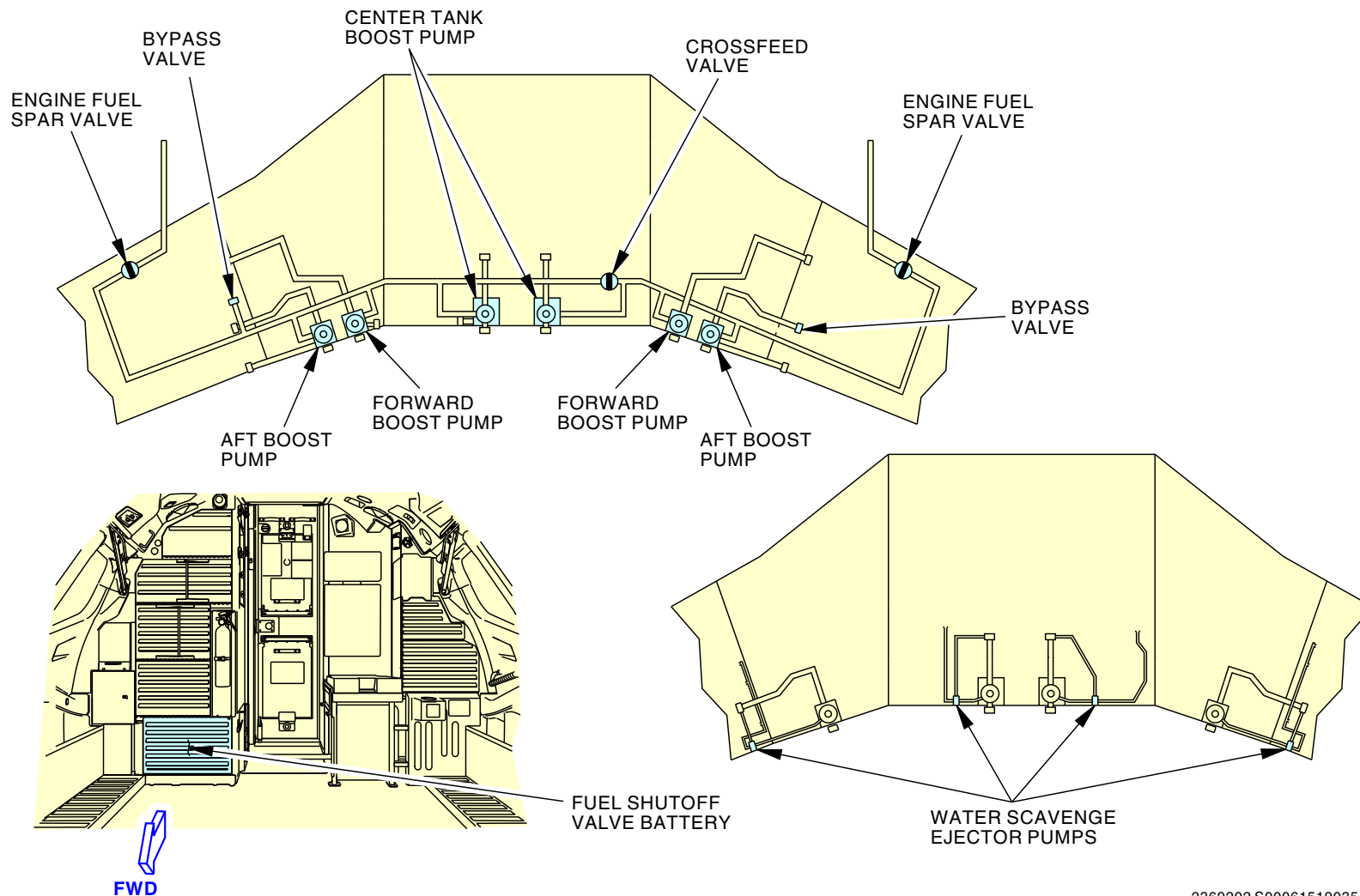
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ENGINE FUEL FEED - COMPONENT LOCATION



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ENGINE FUEL FEED - COMPONENT LOCATION

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**ENGINE FUEL FEED - CENTER TANK BOOST PUMP****General**

The center tank boost pumps supply fuel from the center tank to the engine fuel feed manifold.

The center tank boost pump supplies fuel at a minimum pressure of 23 psi (159 kPa) and a minimum flow rate of 20,000 pph (9,071 kgph).

Each pump assembly has a motor and a housing.

Location

The center tank boost pumps are on the rear spar in the wheel well.

The pressure switch for the right and left center tank pump is on the rear spar. Access to the left center tank boost pump pressure switch is through the left wheel well. Access to the right center tank boost pump pressure switch is through the right wheel well.

Center Tank Boost Pump Housing

The housing contains these components:

- Discharge check valve
- Removal check valve
- Vapor discharge check valve.

The discharge check valve is a flapper type valve. The discharge check valve prevents fuel flow from the engine feed manifold through the pump.

The removal check valve is a poppet type valve. The removal check valve closes when you remove the motor. This allows motor removal without defueling the center tank.

The vapor discharge check valve prevents a reverse flow of fuel, from the tank, through the pump.

Center Tank Boost Pump Motor

The motor has the impeller and uses 3-phase, 115v ac power. It is inside the housing.

Pressure Switch

The low pressure switch sends a low center tank boost pump pressure signal to the LOW PRESSURE light (P5).

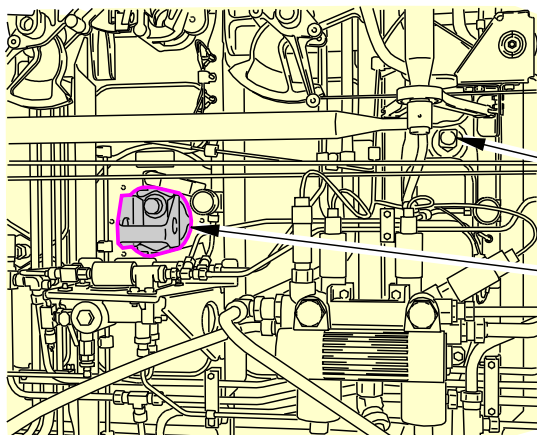
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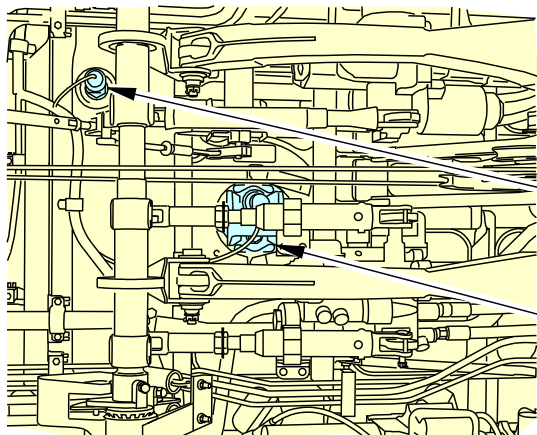
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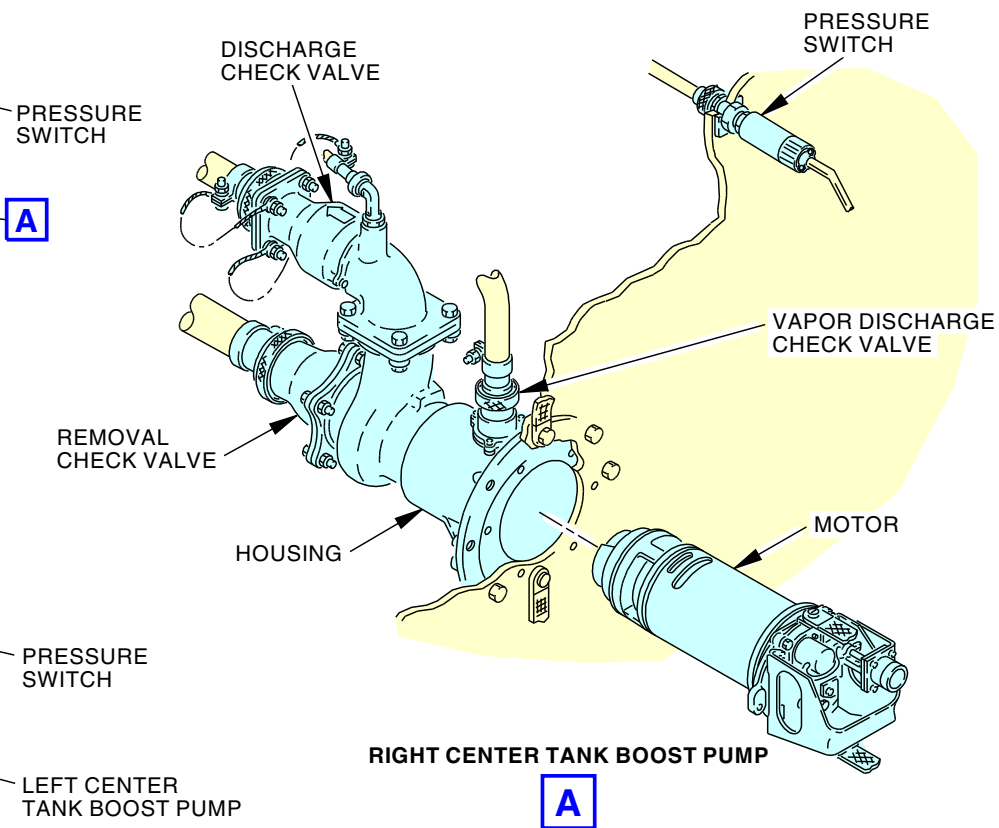
ENGINE FUEL FEED - CENTER TANK BOOST PUMP



WHEEL WELL
(RIGHT SIDE)



WHEEL WELL
(LEFT SIDE)



2369203 S00061519037_V1

ENGINE FUEL FEED - CENTER TANK BOOST PUMP

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**ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - CENTER TANK BOOST PUMP****General**

This page shows control of the left center tank boost pump. Control of the right center tank boost pump is almost the same.

Left Center Tank Boost Pump Control

The center tank left boost pump switch controls the center tank left boost pump relay. The center tank left boost pump relay controls electrical power to the left center tank boost pump.

With the switch in the on position, 115v ac power goes to the relay. With the relay energized, power goes from the 115v ac transfer bus to the left center tank boost pump.

With the switch in the off position, the relay no longer receives 115v ac power. With the relay not energized, the center tank boost pump no longer receives power.

Left Center Tank Boost Pump Auto Shutoff

The left center tank boost pump has an auto shutoff function.

The auto shutoff function will de-energize the center tank left boost pump relay after a time delay of 15 seconds when low boost pump pressure is detected. With the relay not energized, the center tank boost pump no longer receives power.

Fuel Test Panel, P61-8

The auto shutoff function can be tested with the left auto shutoff test switch, S1, on the fuel test panel, P61.

The fuel test panel, P61, is found in the rear of the flight compartment on the right side. The fuel test panel, P61, is not used by the flight crew.

Pressure Indication

A LOW PRESSURE light comes on when the center tank left boost pump switch is in the on position and the left center tank boost pump pressure is 18 psig (124 kPa) or less.

Ground Fault Protection

The center tank left boost pump control relay contains a ground fault protection circuit. It removes power to the left center tank boost pump if there is a short circuit or a phase anomaly in the ac power supply.

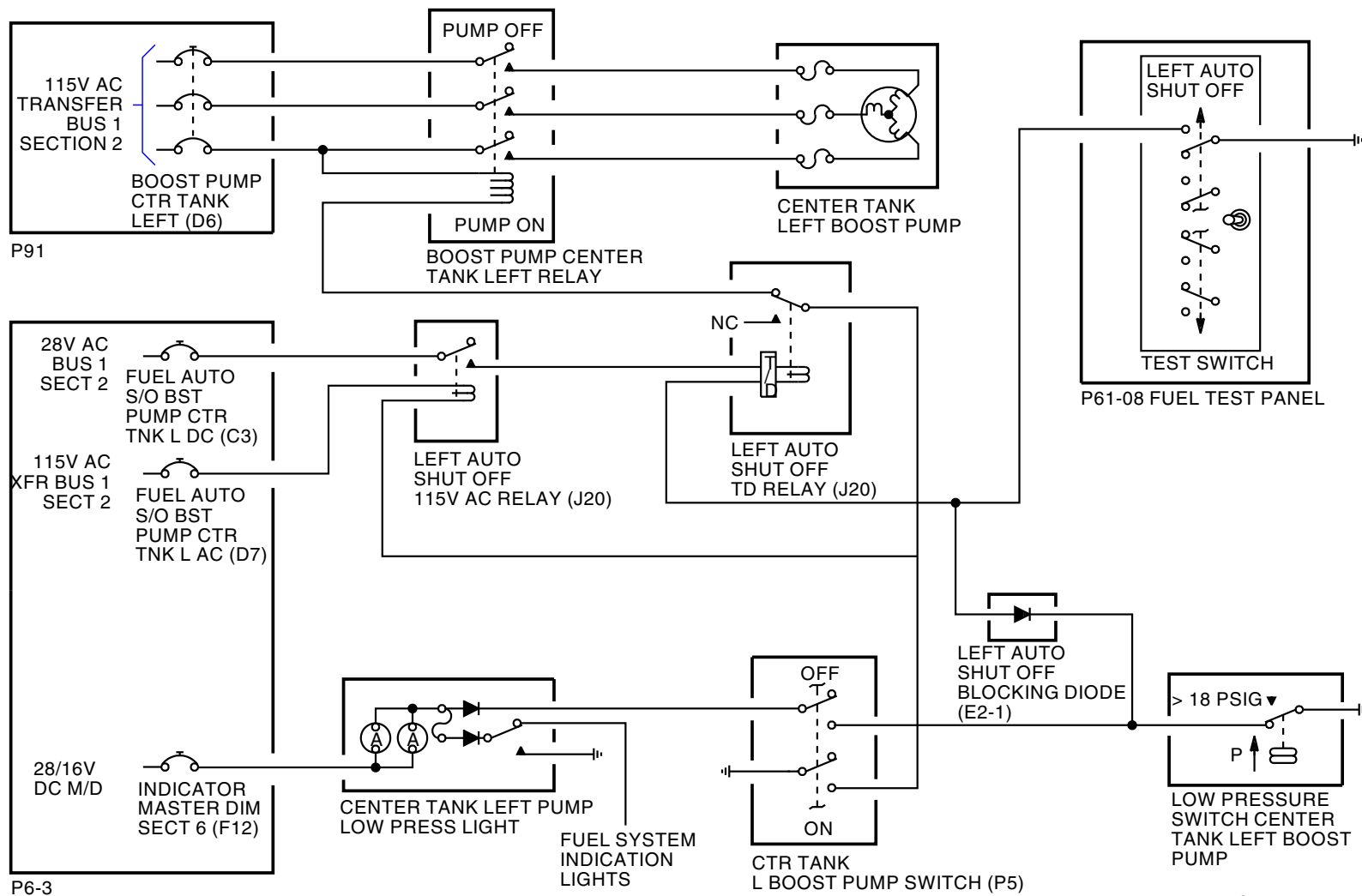
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ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - CENTER TANK BOOST PUMP



ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - CENTER TANK BOOST PUMP

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**ENGINE FUEL FEED - MAIN TANK NO. 1 FORWARD AND AFT BOOST PUMPS****General**

The boost pumps supply fuel from main tank 1 to the engine feed manifold.

The boost pumps supply fuel at a minimum pressure of 10 psig (69 kPa) at a flow rate of 20,000 pph (9,071 kgph).

Each of the boost pumps in main tank 1 and main tank 2 are interchangeable.

Location

The left forward fuel boost pump is installed on the inboard rear spar forward of the main landing gear door. The left aft fuel boost pump is installed outboard of the left forward fuel boost pump on the rear spar.

The left fuel boost pump pressure switches are above the forward and aft fuel boost pumps.

Boost Pump Housing

The housing contains these components:

- Discharge check valve
- Removal check valve
- Vapor discharge check valve.

The discharge check valve is a flapper type valve. The discharge check valve prevents fuel flow from the engine feed manifold through the pump.

The removal check valve is a poppet type valve. The removal check valve closes when you remove the motor. This permits motor removal without defueling tank 1.

The vapor discharge check valve prevents a reverse flow of fuel, from the tank, through the pump.

Boost Pump Motor

The motor has the impeller and uses three-phase, 115v ac power. It is inside the housing.

Pressure Switch

The low pressure switch sends a low boost pump pressure signal to the LOW PRESSURE light (P5).

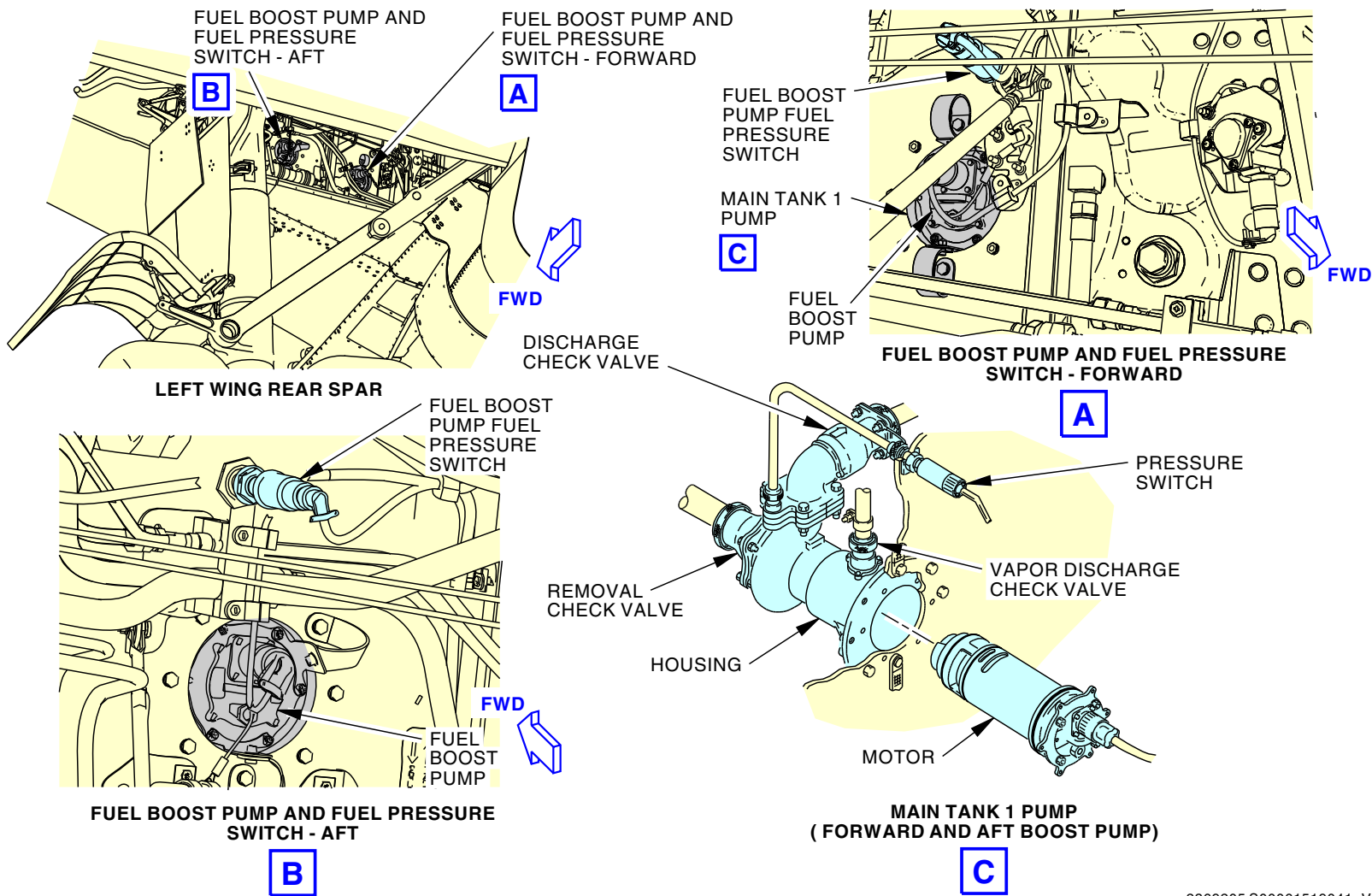
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ENGINE FUEL FEED - MAIN TANK NO. 1 FORWARD AND AFT BOOST PUMPS



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ENGINE FUEL FEED - MAIN TANK 1 FORWARD AND AFT BOOST PUMPS

**ENGINE FUEL FEED - MAIN TANK NO. 2 FORWARD AND AFT BOOST PUMPS****General**

The boost pumps supply fuel from main tank 2 to the engine feed manifold.

The boost pumps supply fuel at a minimum pressure of 10 psi (69 kPa) and a minimum flow rate of 20,000 pph (9,071 kgph).

Each of the boost pumps in main tank 2 and main tank 1 are interchangeable.

Location

The right forward fuel boost pump is installed on the inboard rear spar forward of the main landing gear door. The right aft fuel boost pump is installed outboard of the right forward fuel boost pump on the rear spar.

The right fuel boost pump pressure switches are above the forward and aft fuel boost pumps.

Boost Pump Housing

The housing contains these components:

- Discharge check valve
- Removal check valve
- Vapor discharge check valve.

The discharge check valve is a flapper type valve. The discharge check valve prevents fuel flow from the engine feed manifold through the pump.

The removal check valve is a poppet type valve. The removal check valve closes when you remove the motor. This allows motor removal without defueling main tank 2.

The vapor discharge check valve prevents a reverse flow of fuel, from the tank, through the pump.

Boost Pump Motor

The motor has the impeller and uses 115v ac power. It is inside the housing.

Pressure Switch

The low pressure switch sends a low boost pump pressure signal to the LOW PRESSURE light (P5).

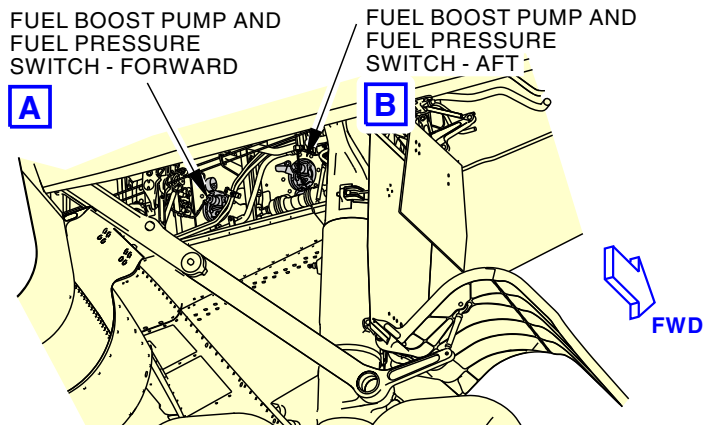
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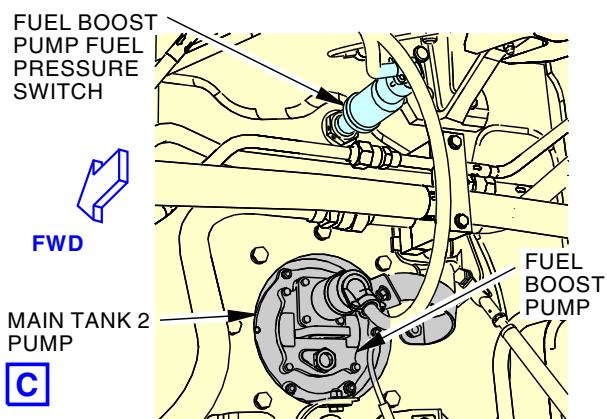
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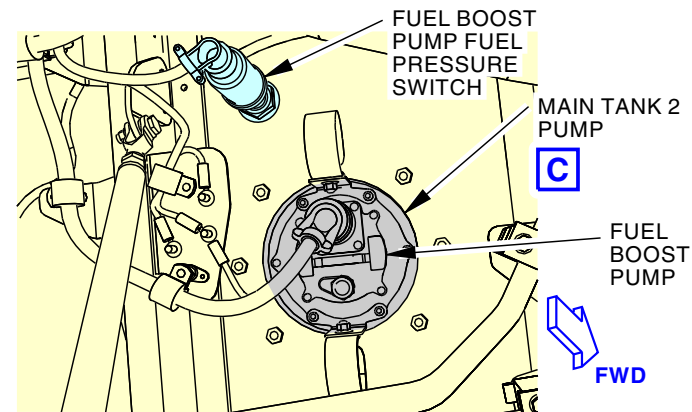
ENGINE FUEL FEED - MAIN TANK NO. 2 FORWARD AND AFT BOOST PUMPS



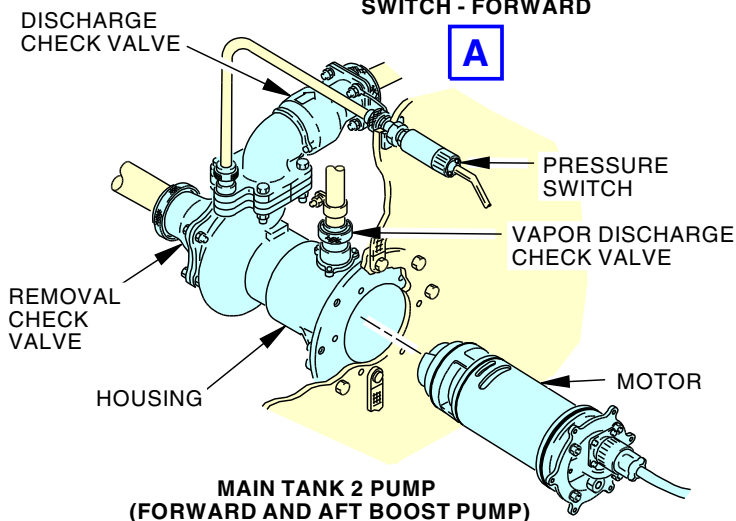
RIGHT WING REAR SPAR



FUEL BOOST PUMP AND FUEL PRESSURE SWITCH - AFT



FUEL BOOST PUMP AND FUEL PRESSURE SWITCH - FORWARD



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ENGINE FUEL FEED - MAIN TANK NO. 2 FORWARD AND AFT BOOST PUMPS

**ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FORWARD AND AFT BOOST PUMP****General**

This page shows control of the left forward boost pump. Control of the left aft, right forward, and right aft boost pump is almost the same.

Left Forward Boost Pump Control

The tank 1 forward boost pump switch controls the tank 1 forward boost pump relay. The tank 1 forward boost pump relay controls power to the left forward boost pump.

With the switch in the ON position, 115v ac power goes to the relay. With the relay energized, power goes from the 115v ac transfer bus to the left forward boost pump.

With the switch in the OFF position, the relay no longer receives 115v ac power. With the relay not energized, the left forward boost pump no longer receives power.

Pressure Indication

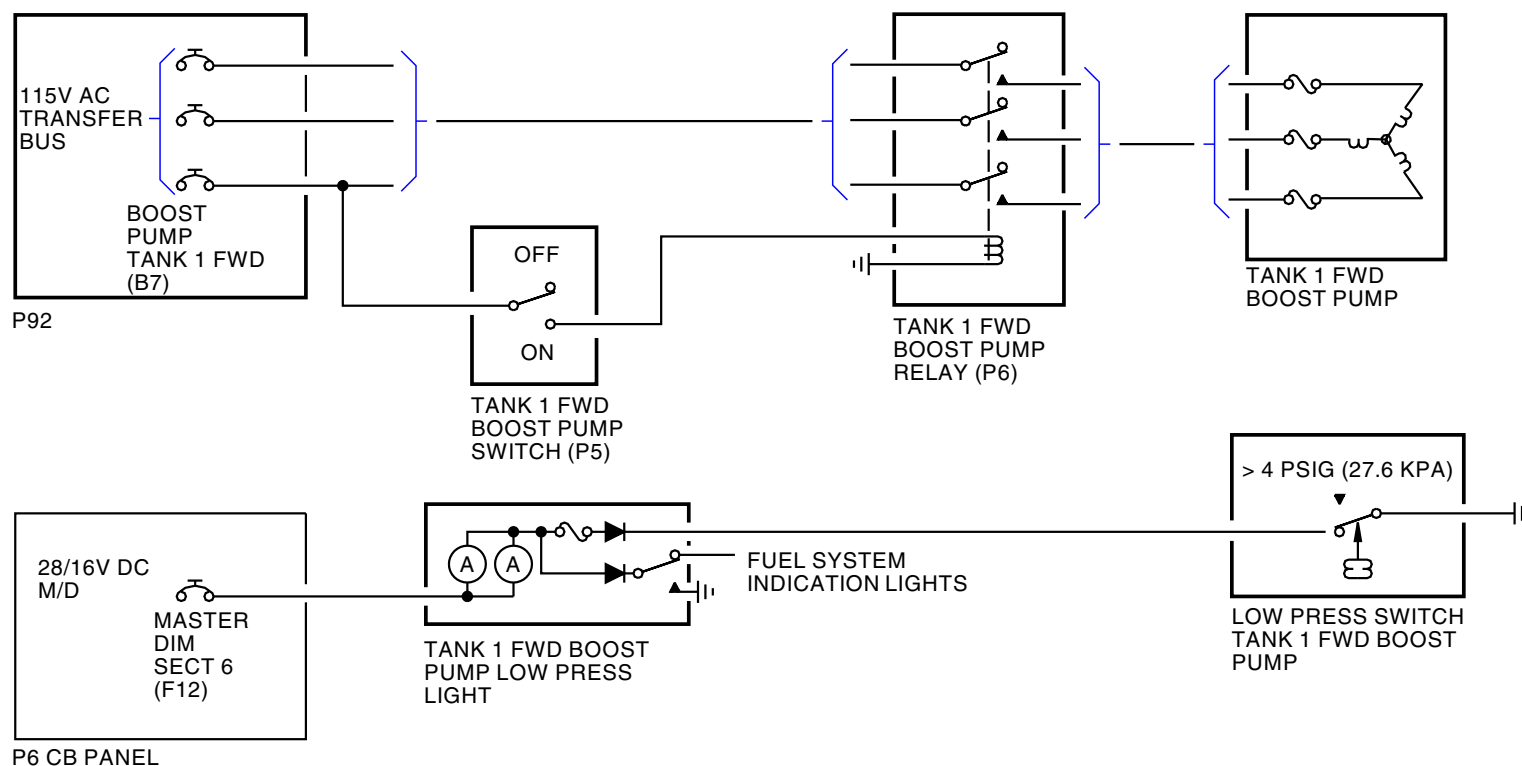
A LOW PRESSURE light comes on when the tank No. 1 forward boost pump pressure is 4 psig (27.6 kPa) or less.

Ground Fault Protection

The tank 1 forward boost pump control relay contains a ground fault protection circuit. It removes power to the tank 1 forward boost pump if there is a short circuit or a phase anomaly in the ac power supply.

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ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FORWARD AND AFT BOOST PUMP


NOTE:

MAIN TANK NO. 1 FORWARD BOOST PUMP IS SHOWN.
MAIN TANK NO. 1 AFT, MAIN TANK NO. 2 FORWARD,
AND MAIN TANK NO. 2 AFT BOOST PUMP ARE ALMOST THE SAME.

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ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FORWARD AND AFT BOOST PUMP

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ENGINE FUEL FEED - FUEL CROSSFEED VALVE

General

The crossfeed valve lets fuel flow between the left and right engine fuel feed manifolds. With the connection of the two engine fuel feed manifolds, one fuel tank supplies fuel to both engines.

The fuel crossfeed valve actuator is interchangeable with the engine fuel spar valve actuator.

Location

The fuel crossfeed valve is on the right wing rear spar. Access is through the right wheel well.

Motor Actuated Valve

The motor actuated valve has these parts:

- Valve body
- Adapter and shaft
- Actuator.

Valve Body

The valve body connects to the left and right engine fuel feed manifold. The valve body has an operating shaft and a butterfly valve (not shown). There are no hard stops for the butterfly valve. The alignment marks show valve position.

Adapter and Shaft

The adapter and shaft attaches between the rear spar and the operating shaft. The adapter has a mount plate and an actuator adapter plate.

The mount plate attaches to the rear spar. The actuator adapter plate attaches to the mount plate with adjustment screws. You loosen the adjustment screws to rotate the actuator adapter plate. You turn the actuator adapter plate to align the butterfly valve with the actuator.

Actuator

The actuator is a 28v dc motor. It has a manual override lever that permits valve operation without electrical power. The lever aligns with valve position indicators on the adapter. This shows valve position.

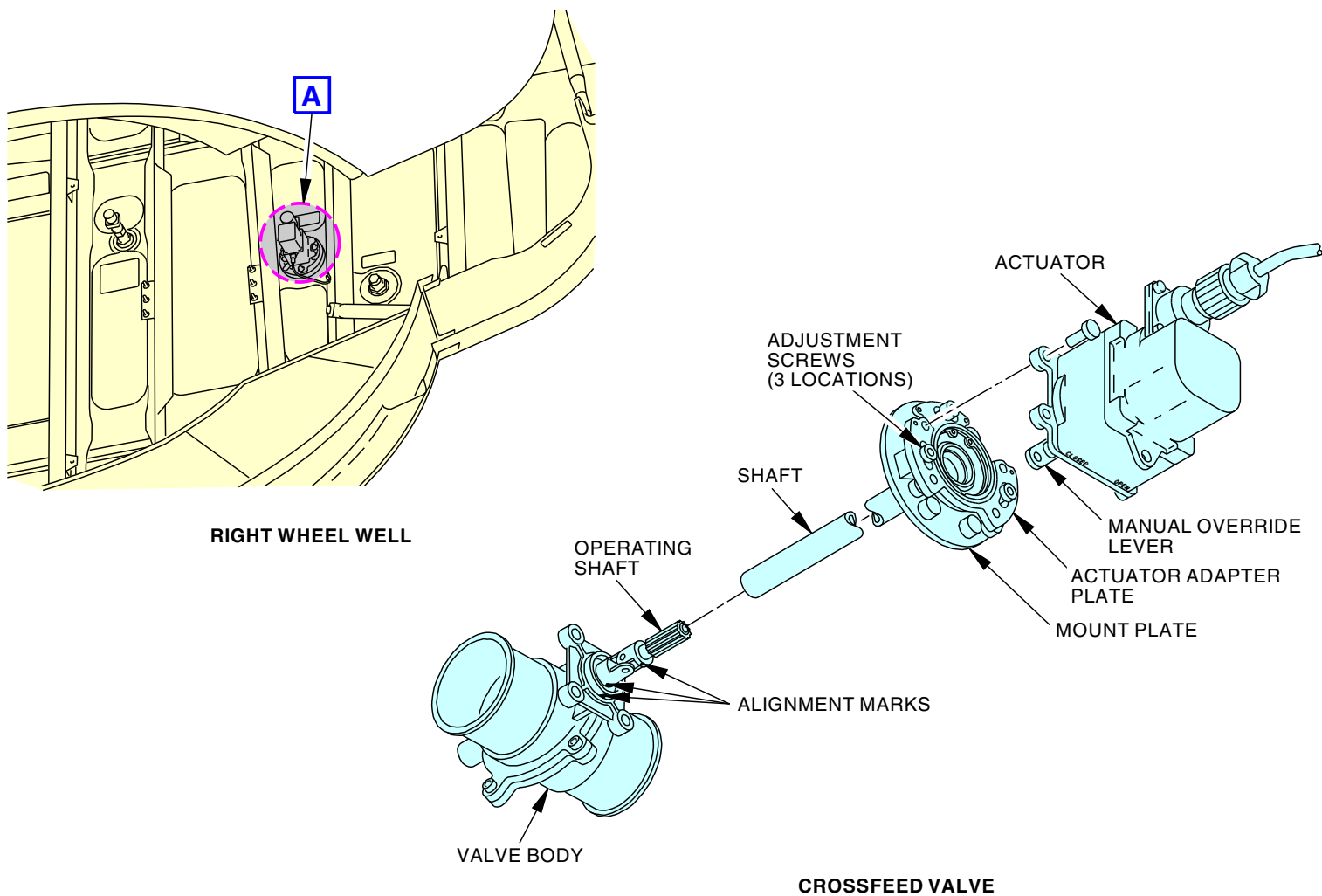
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ENGINE FUEL FEED - FUEL CROSSFEED VALVE



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ENGINE FUEL FEED - FUEL CROSSFEED VALVE

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**ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL CROSSFEED VALVE****General**

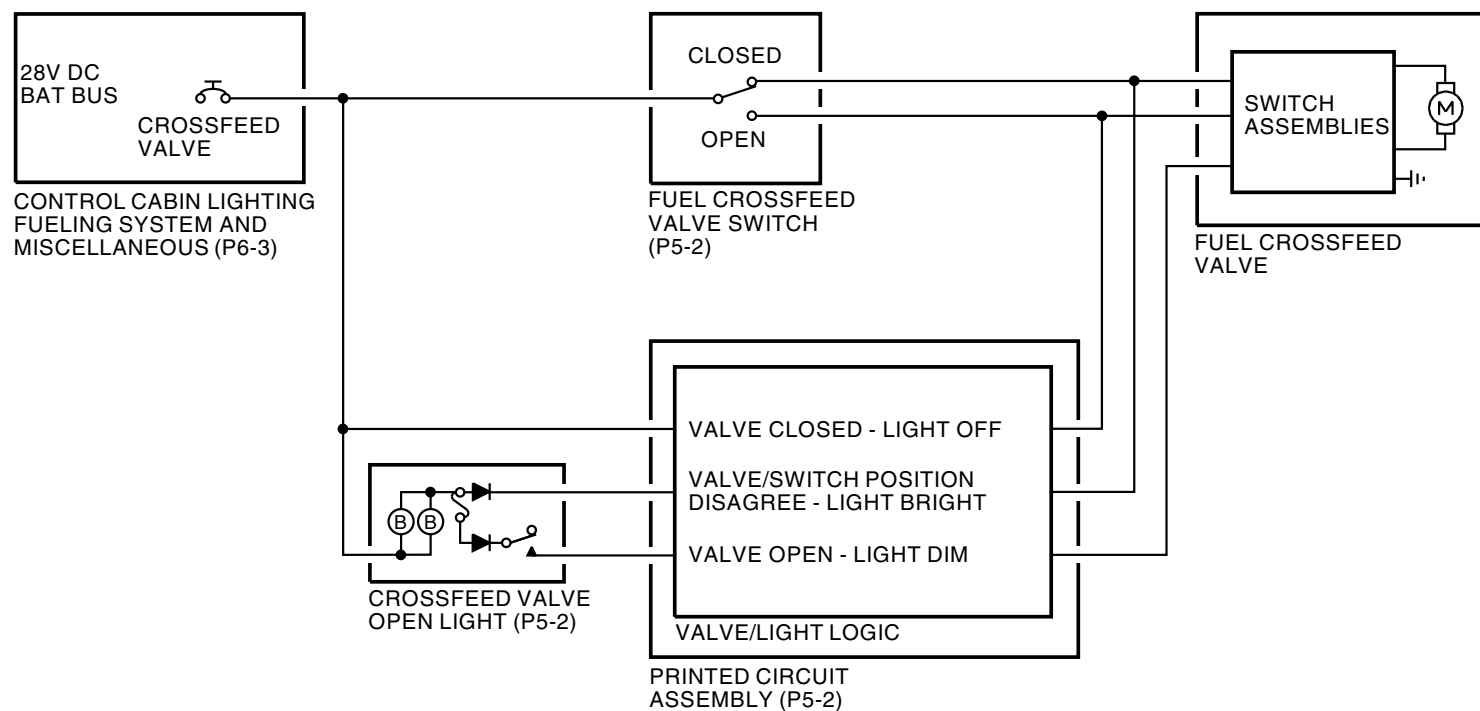
The fuel crossfeed valve switch controls the crossfeed valve. When you move the switch to the open or closed position, 28v dc power goes through a switch assembly to the actuator. The actuator then moves the crossfeed valve to the applicable position.

The printed circuit card assembly controls the operation of the crossfeed valve open light. The printed circuit assembly receives fuel crossfeed valve position and fuel crossfeed valve switch position information.

When the fuel crossfeed valve is closed, the crossfeed valve open light is off. When the fuel crossfeed valve position and fuel crossfeed valve switch position disagree, the crossfeed valve open light is on bright. When the fuel crossfeed valve is open, the crossfeed valve open light is on dim.

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ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL CROSSFEED VALVE



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ENGINE FUEL FEED - FUNCTIONAL DESCRIPTION - FUEL CROSSFEED VALVE

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**ENGINE FUEL FEED - ENGINE FUEL SPAR VALVE****General**

The fuel spar valve controls fuel flow from the engine fuel feed manifold to the engine fuel supply line.

Location

The left fuel spar valve is on the left wing front spar outboard of the engine strut. Access is through an access panel on the left wing leading edge.

The right fuel spar valve is on the right wing front spar outboard of the engine strut. Access is through an access panel on the right wing leading edge.

Motor Actuated Valve

The motor actuated valve has these parts:

- Valve body
- Adapter and shaft
- Actuator.

Valve Body

The valve body connects between the engine fuel feed manifold and the engine fuel supply line. The valve body has a shaft and a butterfly valve (not shown). The alignment marks show valve position.

Adapter and Shaft

The adapter and shaft attaches between the front spar and the operating shaft. The adapter has a mount plate and an actuator adapter plate.

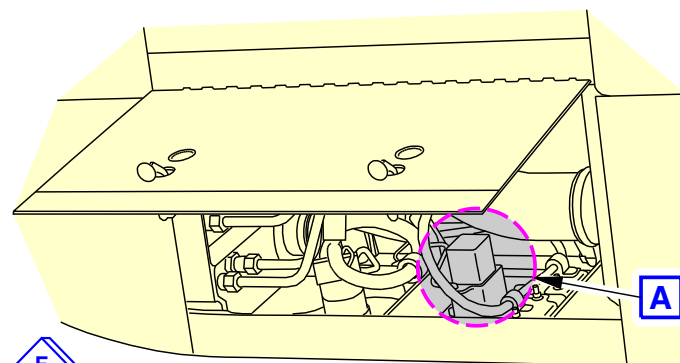
The mount plate attaches to the front spar. The actuator adapter plate attaches to the mount plate with adjustment screws. You loosen the adjustment screws to rotate the actuator adapter plate. You turn the actuator adapter plate to align the butterfly valve with the actuator.

Actuator

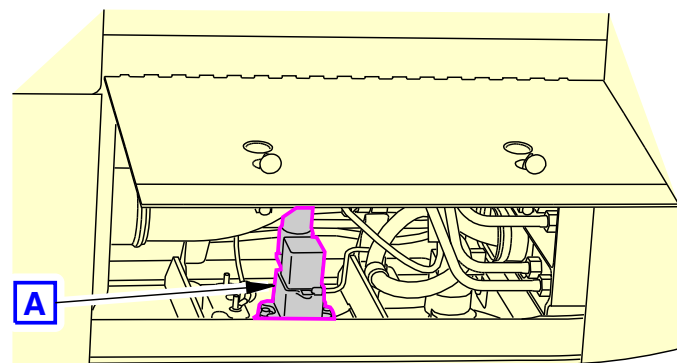
The actuator is a 28v dc motor. It has a manual override lever that permits valve operation without electrical power. The lever aligns with valve position indicators on the adapter. This shows valve position.

The fuel spar valve actuator is interchangeable with the crossfeed valve actuator.

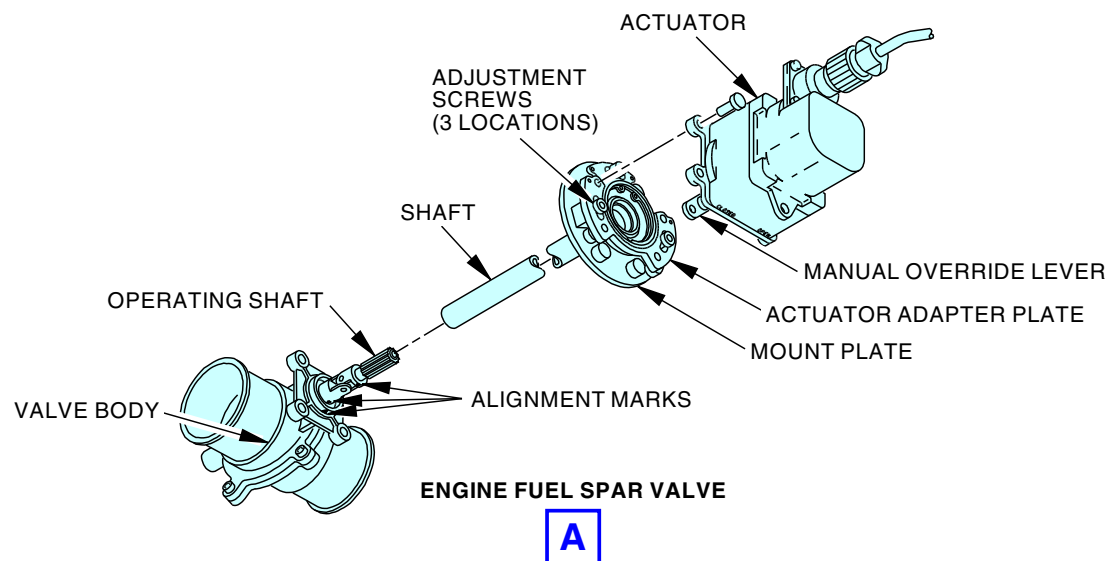
ENGINE FUEL FEED - ENGINE FUEL SPAR VALVE



LEFT WING LEADING EDGE



RIGHT WING LEADING EDGE



ENGINE FUEL FEED - ENGINE FUEL SPAR VALVE

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**ENGINE FUEL FEED - ENGINE FUEL SPAR VALVE OPERATION****General**

The operation of the left engine fuel spar valve is shown. The operation of the right engine fuel spar valve is almost the same.

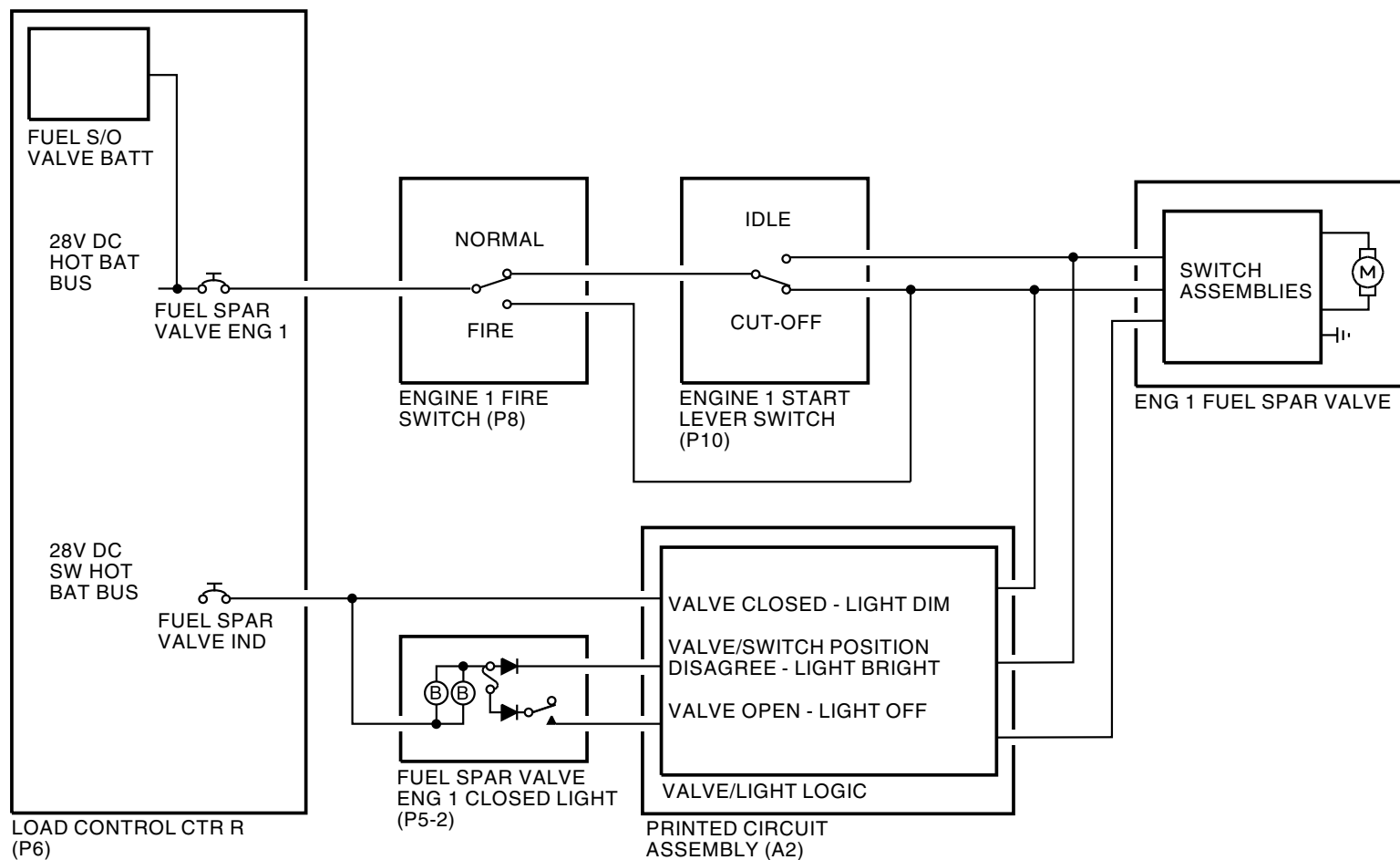
The engine start lever controls the engine fuel spar valve. When you move the lever to the idle or cut-off position, 28v dc power goes through a switch assembly to the actuator. The actuator then moves the engine fuel spar valve to the correct position.

When the fuel spar valve is closed, the fuel valve closed light is on dim. When the fuel spar valve position and engine start lever switch position disagree, the fuel spar valve closed light is on bright. When the fuel spar valve is open, the fuel spar valve closed light is off.

The fuel shutoff valve battery makes sure that the fuel system always has power to close the engine fuel spar valve.

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ENGINE FUEL FEED - ENGINE FUEL SPAR VALVE OPERATION



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ENGINE FUEL FEED - ENGINE FUEL SPAR VALVE OPERATION

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**ENGINE FUEL FEED - FUEL SHUTOFF VALVE BATTERY****Purpose**

The fuel shutoff valve battery makes sure that the fuel system always has power to close these shutoff valves:

- Engine fuel shutoff valve
- APU fuel shutoff valve.

Components

The fuel shutoff valve battery and charger has these components:

- Aluminum case
- Battery assembly
- Printed circuit board assembly.

Battery Assembly

The battery assembly consists of 22 nickel-cadmium batteries and a temperature sensor. The batteries are connected in series to supply 28v dc to the valve actuators.

Printed Circuit Board Assembly

The printed circuit board assembly has a switch circuit and a charge circuit.

The switch circuit monitors the voltage of the hot battery bus. If the voltage goes below 22v, the switch circuit supplies power from the fuel shutoff battery to the valve actuator circuits.

The charge circuit uses power from dc bus 2 to charge the batteries.

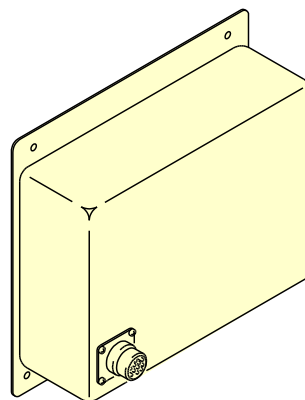
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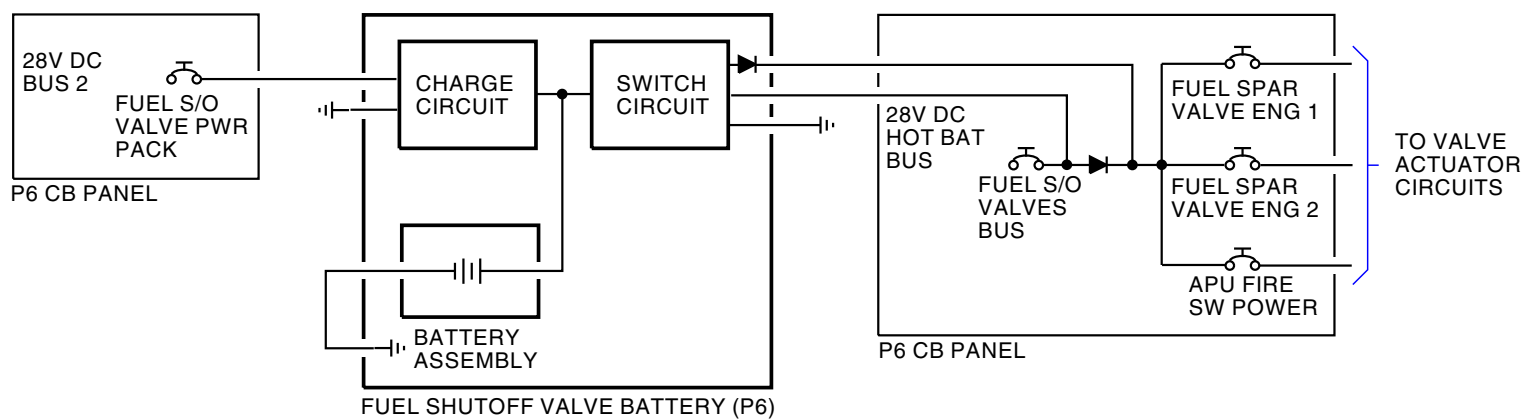
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ENGINE FUEL FEED - FUEL SHUTOFF VALVE BATTERY



FUEL SHUTOFF VALVE BATTERY



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ENGINE FUEL FEED - FUEL SHUTOFF VALVE BATTERY

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**ENGINE FUEL FEED - WATER SCAVENGE EJECTOR PUMP****General**

The water scavenge ejector pumps remove water from the low points in each tank to prevent corrosion.

Location

The water scavenge ejector pumps are on the rear spar. There is one water scavenge ejector pump in main tank No. 1 and one water scavenge ejector pump in main tank No. 2. Access to the water scavenge ejector pump for main tank No. 1 is through an access panel on the bottom of the left wing. Access to the water scavenge ejector pump in main tank No. 2 is through an access panel on the bottom of the right wing.

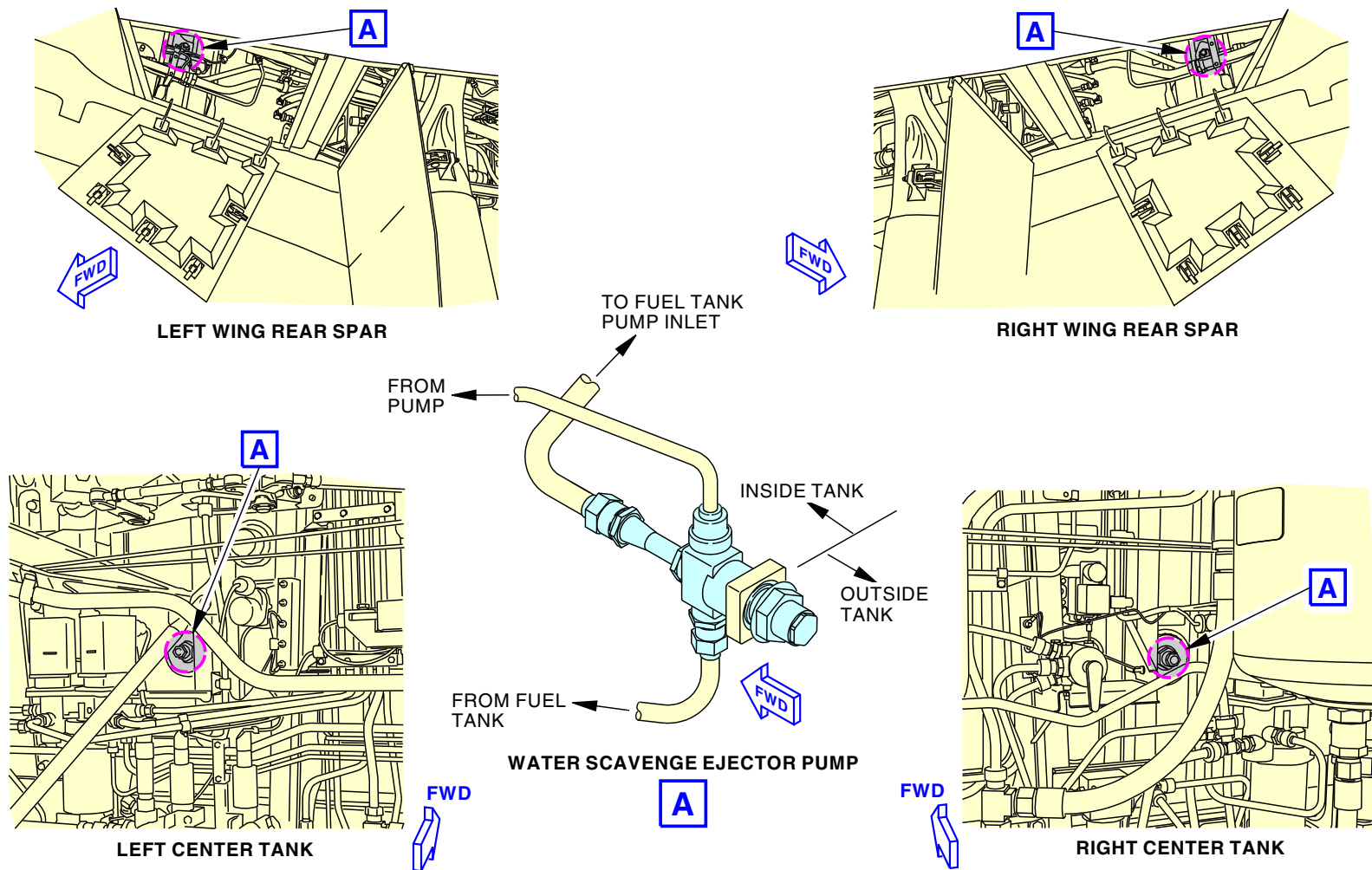
There are two water scavenge ejector pumps in the center tank. Access to the water scavenge ejector pump in the left side of the center tank is through the left wheel well. Access to the water scavenge pump in the right side of the center tank is through the right wheel well.

Functional Description

The water scavenge ejector pumps operate automatically when the L & R center tank boost pumps and the main tank aft boost pumps are on. The water scavenge ejector pumps use fuel flow from the L & R center tank and main tank aft boost pumps as motive flow. The motive flow through the water scavenge ejector pump causes a suction. This suction takes water and fuel from the low points in each tank. The water and fuel that comes out of the water scavenge ejector pump goes to the L & R center tank and main tank aft boost pump inlets.

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ENGINE FUEL FEED - WATER SCAVENGE EJECTOR PUMP



ENGINE FUEL FEED - WATER SCAVENGE EJECTOR PUMP

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**ENGINE FUEL FEED - OPERATION****Fuel Panel**

The fuel panel is on the P5 overhead panel. Switches on the panel control the boost pumps and the crossfeed valve.

Boost pump LOW PRESSURE lights come on when boost pump pressure is low.

Center tank boost pump LOW PRESSURE lights come on when the center tank boost pump switch is in the ON position and center tank boost pump pressure is low.

SPAR VALVE CLOSED lights come on dim when the engine fuel spar valve is closed. The SPAR VALVE CLOSED lights come on bright when there is a disagreement between the switch and valve position. The SPAR VALVE CLOSED lights are off when the engine fuel spar valve is open.

The crossfeed VALVE OPEN light comes on dim when the crossfeed valve is open. The crossfeed VALVE OPEN light comes on brightly when there is a disagreement between the switch and valve position. The crossfeed VALVE OPEN light is off when the crossfeed valve is closed.

Center Tank Engine Fuel Supply

Usually all pump switches are in the ON position at the beginning of a flight. The center tank supplies fuel to the engines. When the center tank is empty, you turn the center tank boost pumps to the OFF position.

Main Tank No. 1 and Main Tank No. 2 Fuel Supply

When the center tank is empty, and the boost pumps are on, fuel goes from the main tanks to the engines.

Crossfeed Operation

Fuel goes through the crossfeed valve to correct an imbalance between main tank No. 1 and main tank No. 2.

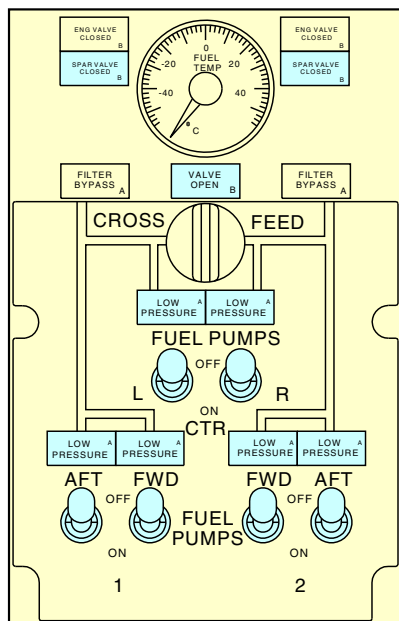
To correct an imbalance, open the crossfeed valve and turn off the boost pumps in the fuel tank that has less fuel.

Suction Operation

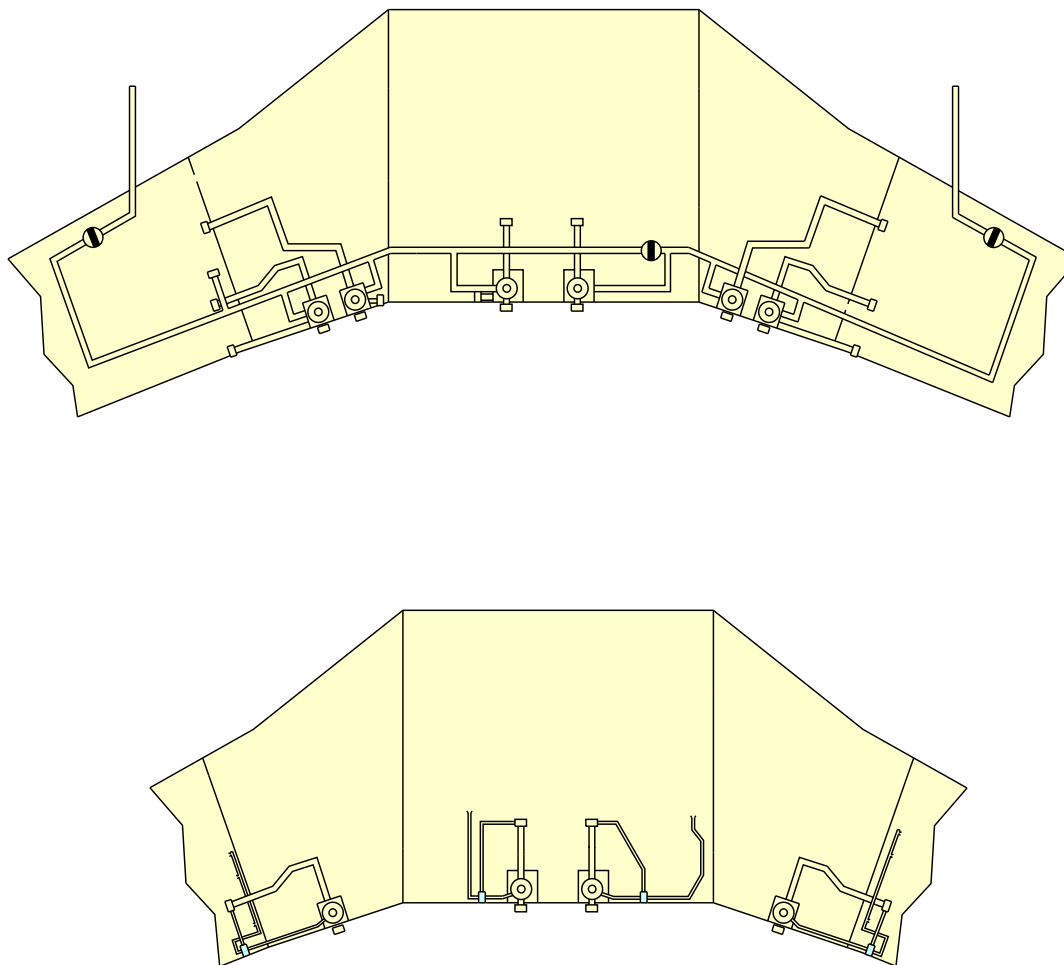
Suction supply from main tank No. 1 and main tank No. 2 occurs when all the boost pumps in one tank are off and the crossfeed valve is closed. The bypass valve in main tank No. 1 and/or main tank No. 2 opens. This lets main tank No. 1 and/or main tank No. 2 supply fuel to the engines. The engines can only suction fuel from main tank No. 1 and main tank No. 2.

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ENGINE FUEL FEED - OPERATION



FUEL SYSTEM PANEL (P5-2)



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ENGINE FUEL FEED - OPERATION

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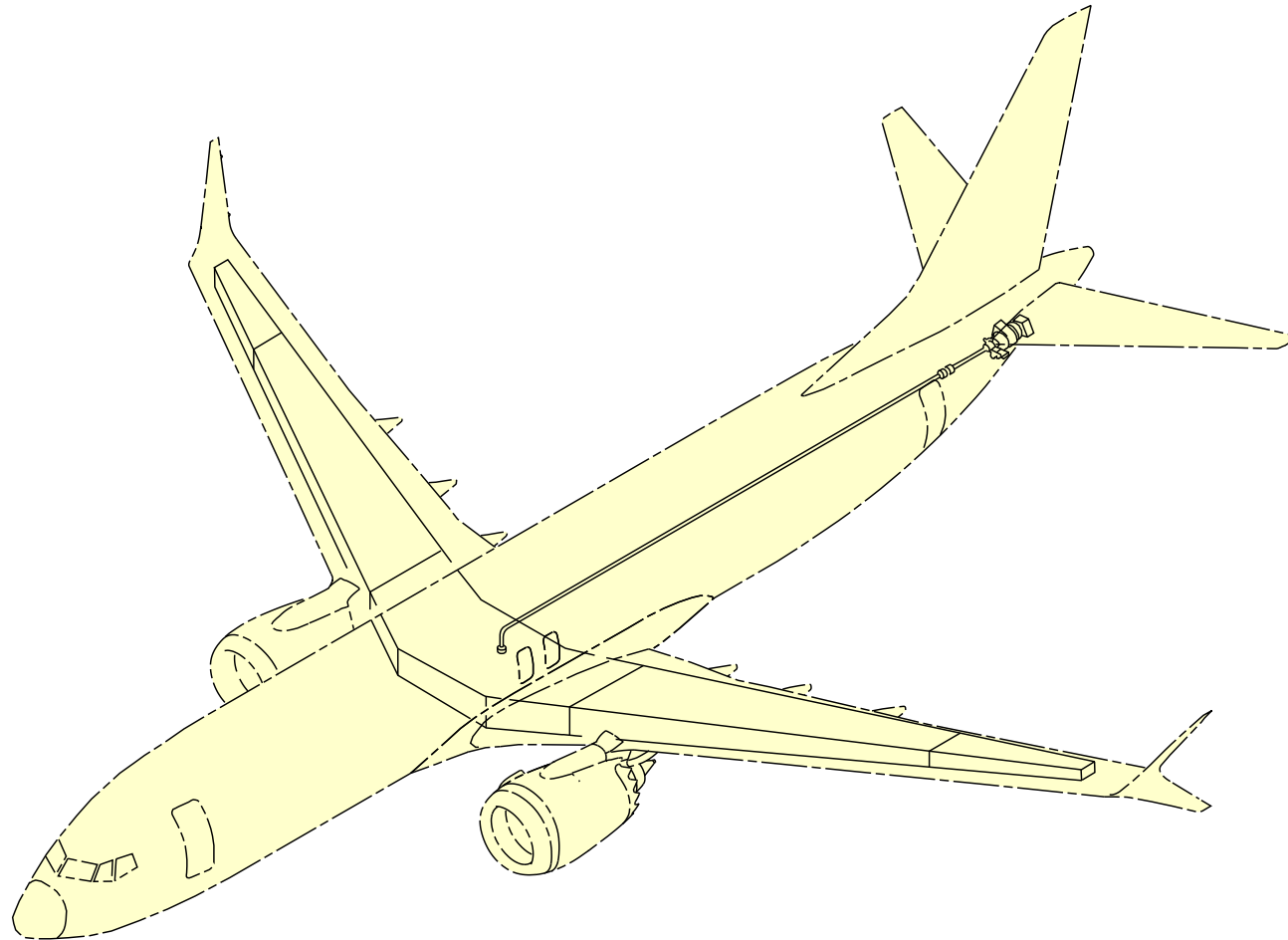
APU FUEL FEED - INTRODUCTION

Purpose

The APU fuel feed system supplies fuel to the APU.

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APU FUEL FEED - INTRODUCTION



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APU FUEL FEED - INTRODUCTION

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APU FUEL FEED - GENERAL DESCRIPTION

General

The APU fuel feed system supplies fuel from any tank to the APU.

APU Fuel Feed

The center tank boost pumps or the boost pumps in the No. 1 and 2 main tanks supply fuel to the APU. If the main tank boost pumps are off, the APU can suction feed fuel from No. 1 main tank. Fuel check valves in the system prevent reverse flow of fuel into the No. 1 main tank.

Control

The Electronic Control Unit (ECU) controls fuel flow to the APU. The ECU receives inputs from these items:

- APU master switch
- Fire protection system
- APU sensors.

The ECU uses these inputs to control the APU fuel shutoff valve.

Electrical power from DC battery bus makes sure that the fuel system always has power to close the APU fuel shutoff valve.

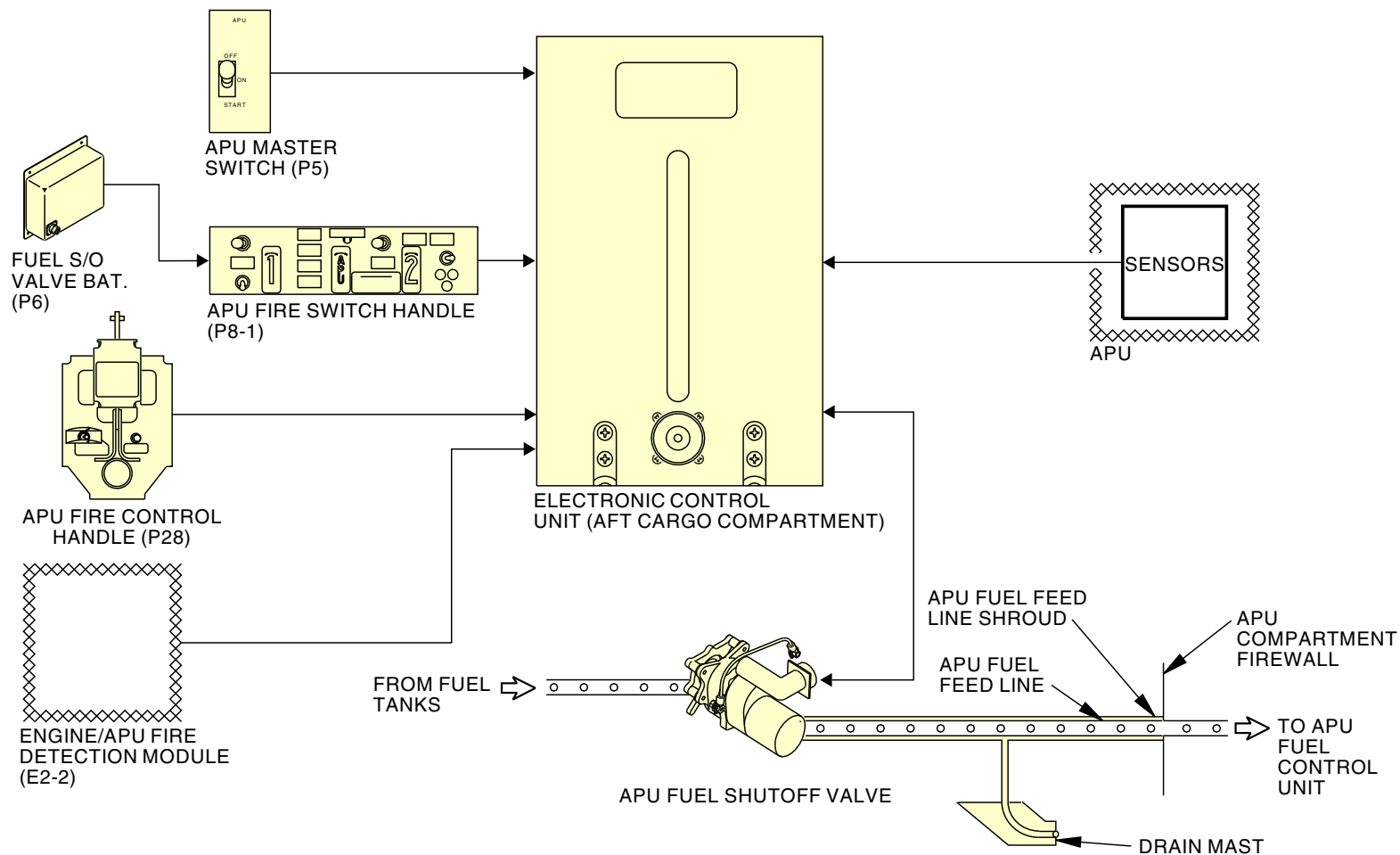
Fuel Supply Line and Shroud

The APU fuel feed line sends fuel from the APU fuel shutoff valve to the APU fuel control unit.

A shroud collects fuel leaks from the APU fuel feed line. The shroud sends the fuel overboard through a drain mast.

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APU FUEL FEED - GENERAL DESCRIPTION



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APU FUEL FEED - GENERAL DESCRIPTION

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APU FUEL FEED - COMPONENT LOCATION

General

The APU fuel feed system has these components:

- APU fuel feed line
- APU fuel feed line shroud
- APU fuel shutoff valve.

APU Fuel Feed Line

The APU fuel feed line starts in main tank 1, goes through the center tank, then aft to the APU.

APU Fuel Feed Line Shroud

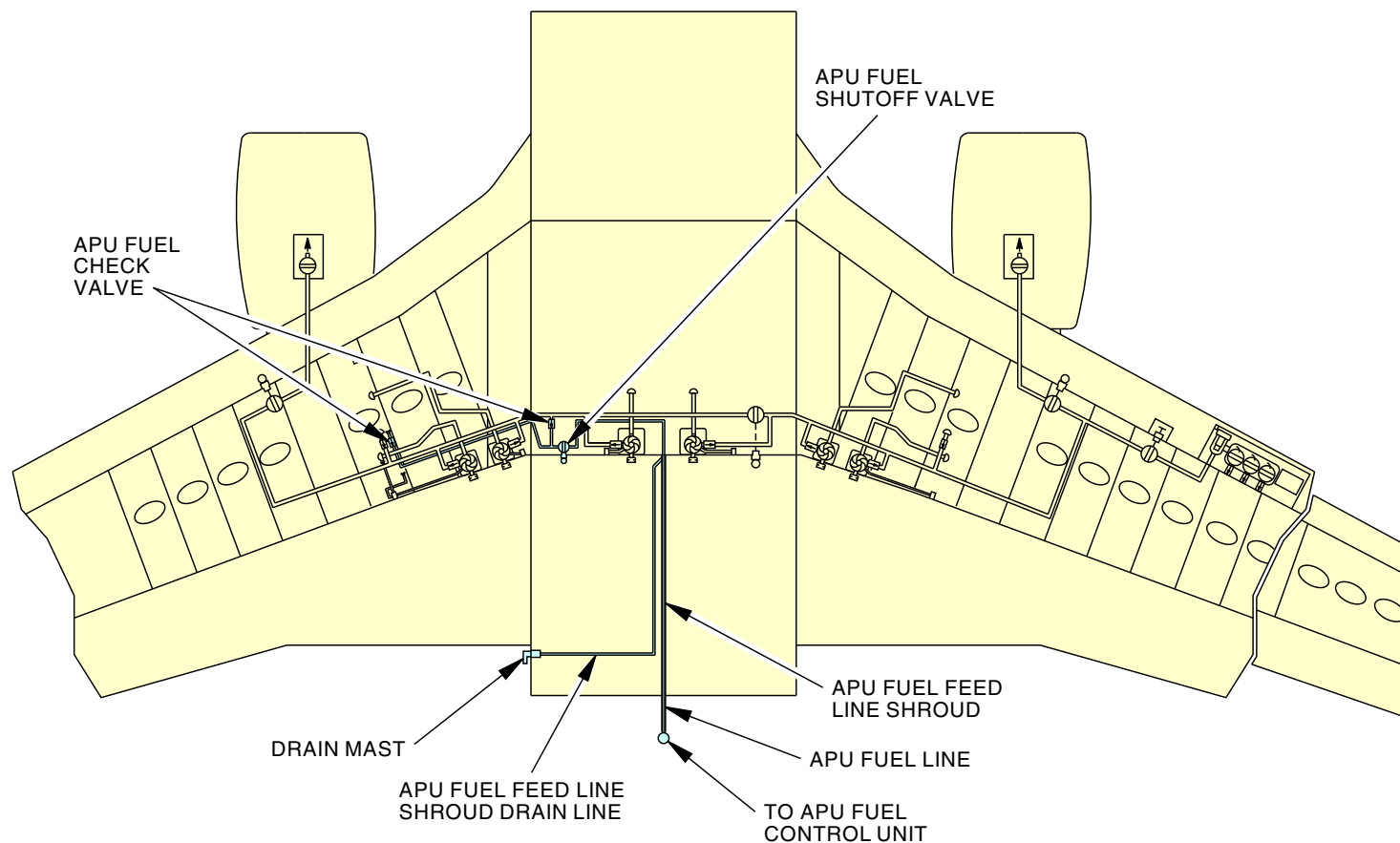
The APU fuel feed line shroud surrounds the APU fuel feed line. The shroud has a drain line that connects to a drain mast on the bottom of the left wing to body fairing.

APU Fuel Shutoff Valve

The APU shutoff valve is on the center section rear spar.

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APU FUEL FEED - COMPONENT LOCATION



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APU FUEL FEED - COMPONENT LOCATION

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**APU FUEL FEED - APU FUEL SUPPLY LINE, SHROUD, AND DRAIN LINE****APU Fuel Supply Line and Shroud**

In the fuel tanks, the APU supply line is made from aluminum. Outside the tanks, the APU supply line is made from rubber and kevlar and is flexible. An aluminum shroud surrounds the rubber/kevlar APU fuel supply line.

Shroud Drain Line

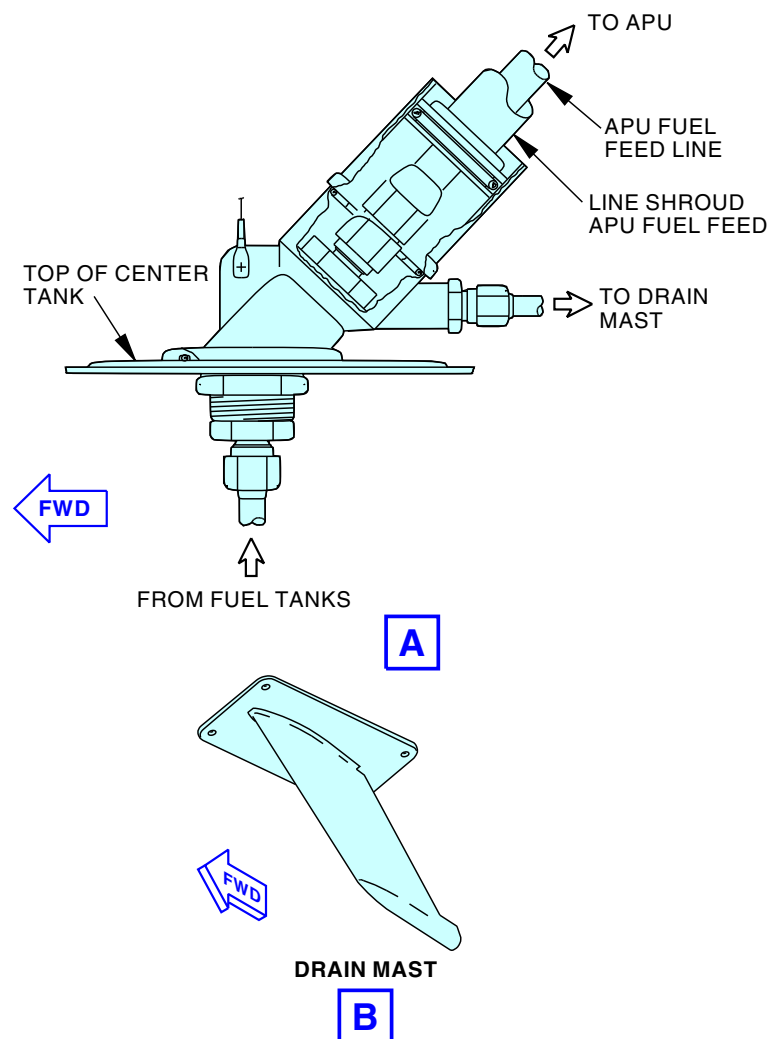
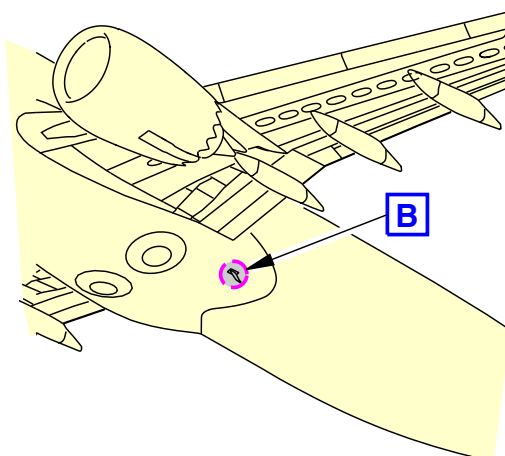
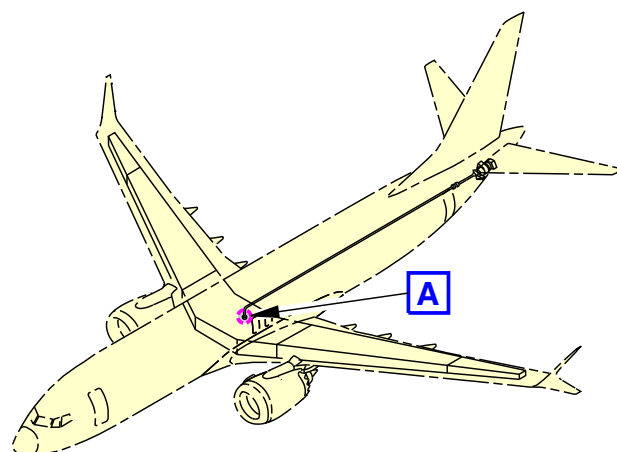
The shroud drain line connects the fuel line shroud to the drain mast. Leaks in the fuel supply line, are contained by the shroud and flow overboard through the drain mast.

NOTE: This drain mast also drains hydraulic fluid from system A and B reservoirs.

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APU FUEL FEED - APU FUEL SUPPLY LINE, SHROUD, AND DRAIN LINE



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APU FUEL FEED - APU FUEL SUPPLY LINE, SHROUD, AND DRAIN LINE

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**APU FUEL FEED - APU FUEL SHUTOFF VALVE****General**

The APU fuel shutoff valve lets fuel flow from the No. 1 main tank or engine fuel feed manifold to the APU.

Location

The APU fuel shutoff valve is on the center section rear spar. Access is through the left wheel well.

Motor Actuated Valve

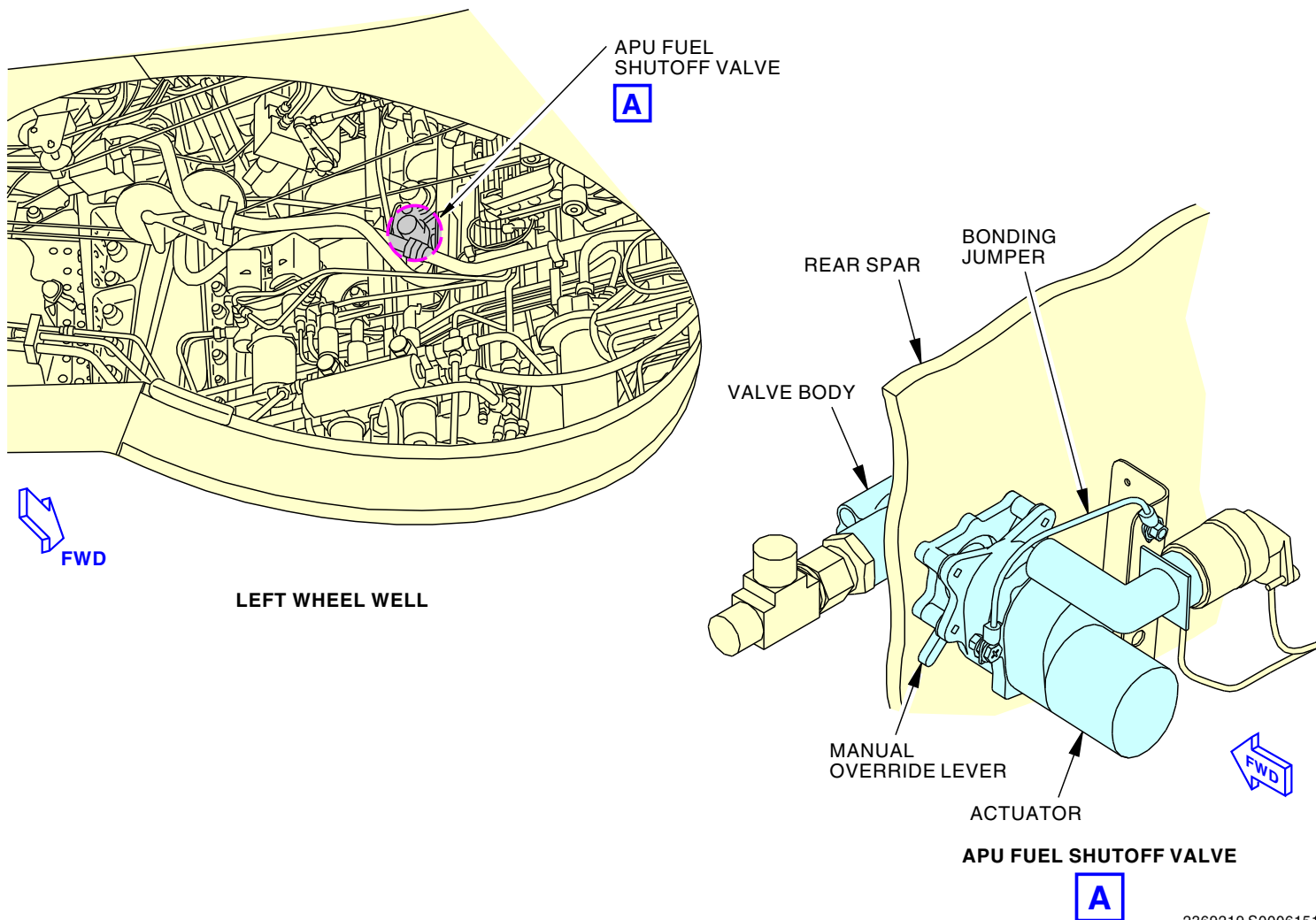
The motor actuated valve has a valve body and an actuator.

With the manifold crossfeed valve closed, the valve body connects to the left engine fuel feed manifold and the APU fuel feed line. The valve is a rotary type valve. The alignment marks show valve position.

The actuator is a 28v dc motor. It has a manual override lever that permits valve operation without electrical power. The lever aligns with valve position indicators on the adapter. This shows valve position.

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APU FUEL FEED - APU FUEL SHUTOFF VALVE



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APU FUEL FEED - APU FUEL SHUTOFF VALVE

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**APU FUEL FEED - APU FUEL SHUTOFF VALVE OPERATION****Control**

The Electronic Control Unit (ECU) controls the APU shutoff valve. The ECU receives input from these components:

- APU switch
- APU fire control handle
- APU fire switch handle
- Engine/APU fire detection module
- APU sensors.

The ECU uses these inputs to open or close the APU shutoff valve.

The APU fuel shutoff valve opens when these conditions occur:

- The APU switch is in the START or ON position and
- The APU fire control handle and the APU fire switch handle are in the NORMAL position and
- The engine/APU fire detection module has not sent a fire signal to the ECU and
- The ECU has not received any out of limits signals from the APU sensors.

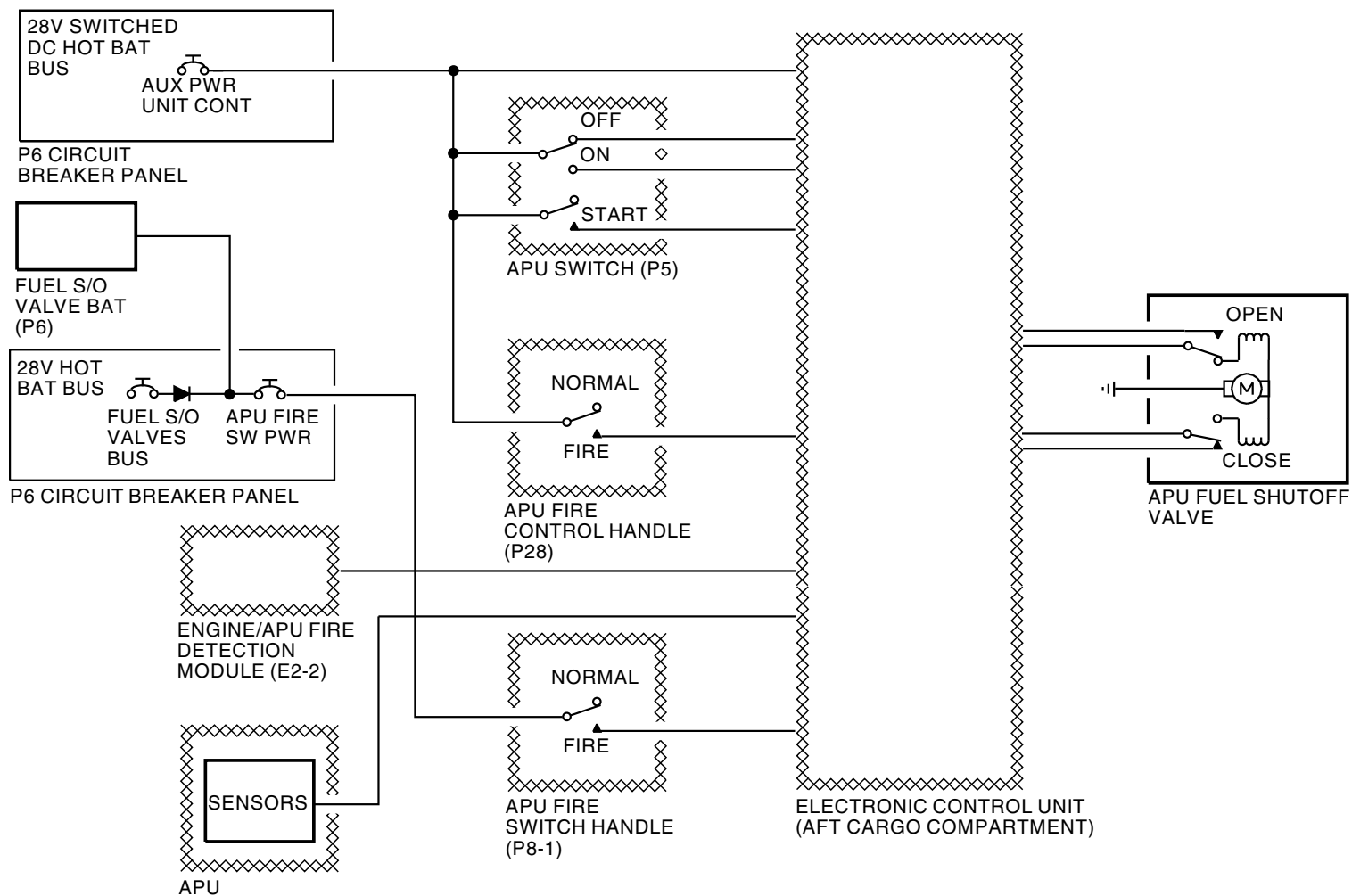
The APU fuel shutoff valve closes when these conditions occur:

- The APU switch is in the OFF position or
- The APU fire control handle is operated to the FIRE position or
- The APU fire switch handle is in the FIRE position or
- The engine/APU fire detection module sends a fire signal to the ECU or
- The ECU receives an out of limits signal from APU sensors.

NOTE: For more information on ECU function, see CHAPTER 49.

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APU FUEL FEED - APU FUEL SHUTOFF VALVE OPERATION



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APU FUEL FEED - APU FUEL SHUTOFF VALVE OPERATION

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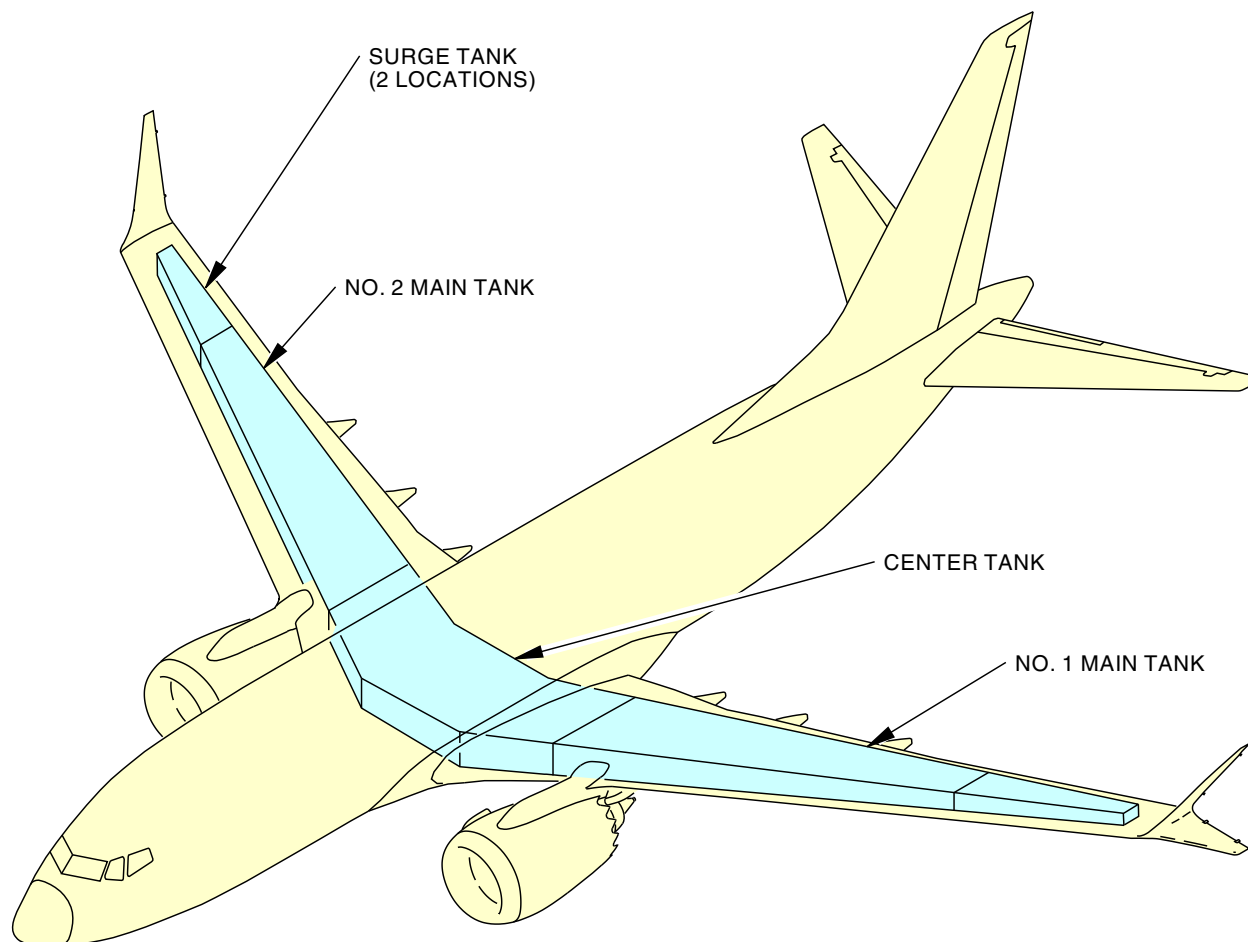
DEFUEL - INTRODUCTION

General

The defuel system removes fuel from the fuel tanks to the refuel station. The defuel system also permits fuel transfer from one fuel tank to another.

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DEFUEL - INTRODUCTION



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DEFUEL - INTRODUCTION

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**DEFUEL - GENERAL DESCRIPTION****General**

The defuel system permits pressure defuel of each tank and suction defuel of main tank 2.

The defuel system also allows fuel transfer on the ground from one fuel tank to another.

Pressure Defuel

You use these to pressure defuel the tanks:

- Refuel station
- Fuel pumps
- Defuel valve
- Crossfeed valve.

Suction Defuel

You use the defuel valve and refuel station to suction defuel main tank 2.

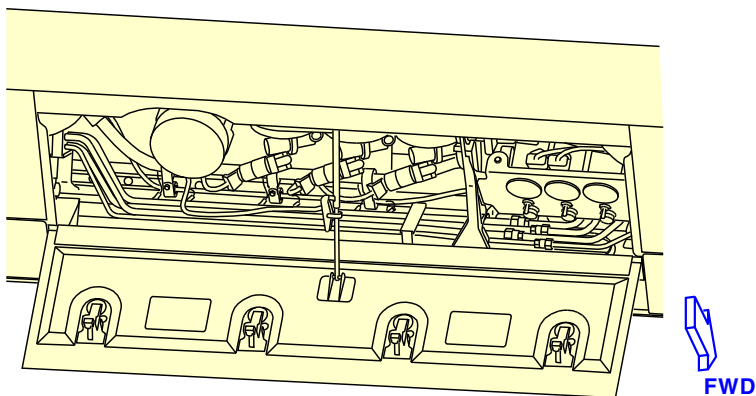
NOTE: This uses the fuel vehicle defueling (suction) pump only. It should only be used when you cannot use electrical power on the airplane.

Fuel Transfer

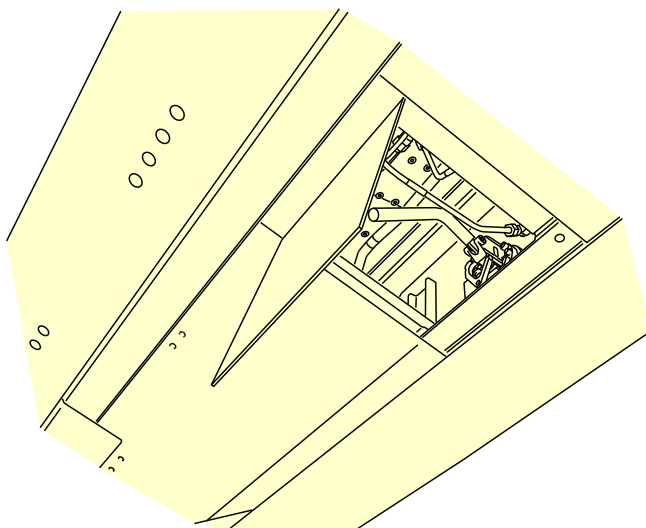
You use the defuel valve, the refuel station, and the fuel control panel to transfer fuel between tanks.

SIA ALL	EFFECTIVITY

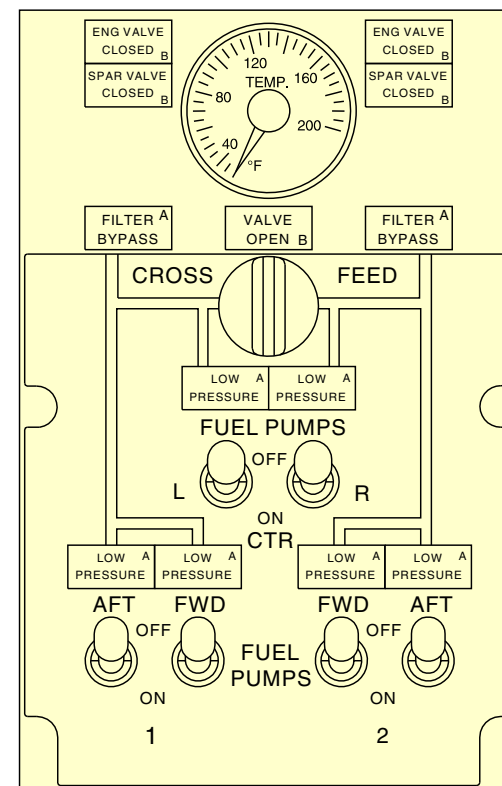
DEFUEL - GENERAL DESCRIPTION



FUELING STATION (P15)



DEFUEL VALVE



FUEL CONTROL PANEL (P5)

2369222 S00061519079_V1

DEFUEL - GENERAL DESCRIPTION

28-26-00

28-26-00-002

SIA ALL

EFFECTIVITY

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ECCN 9E991 BOEING PROPRIETARY - See title page for details



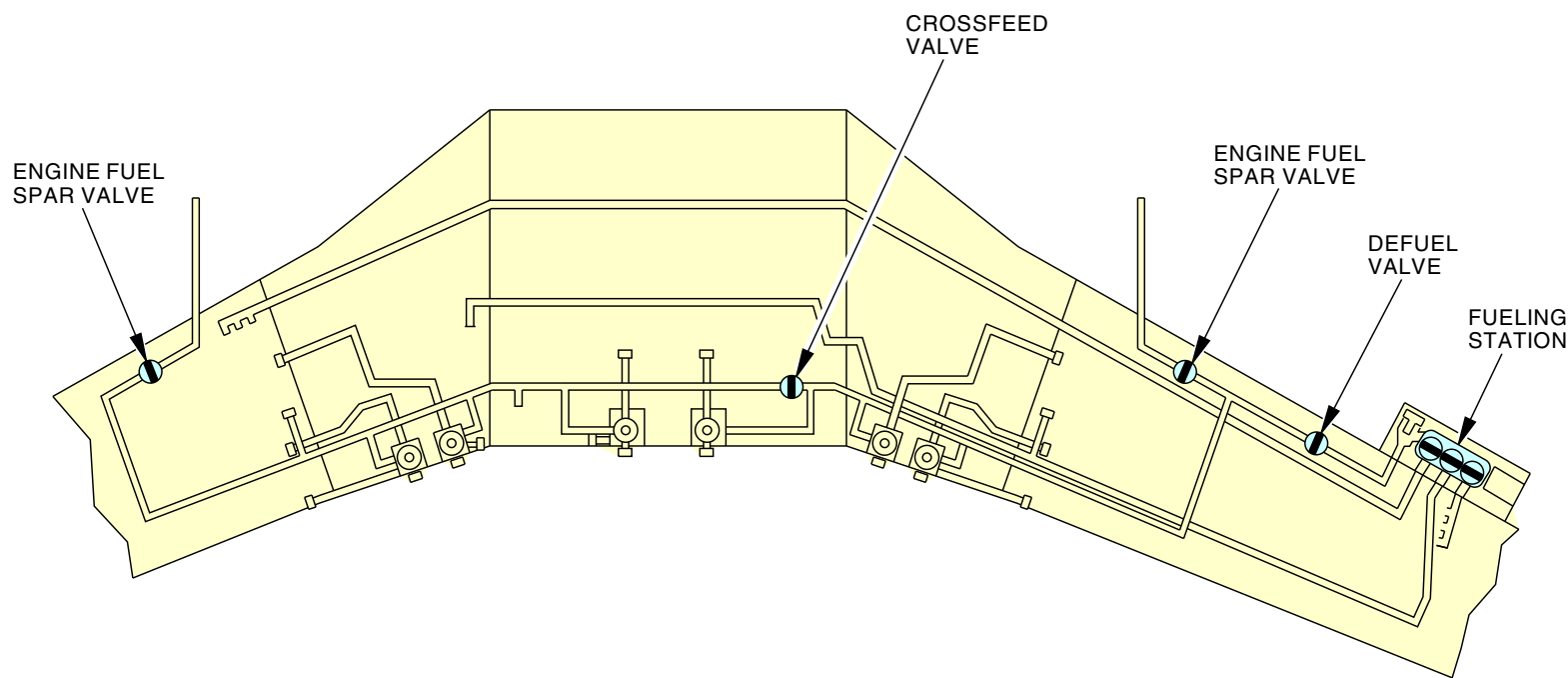
DEFUEL - COMPONENT LOCATION

Location

The defuel valve is located on the right wing front spar. The defuel valve connects between the right engine fuel feed manifold and refuel station tubing.

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DEFUEL - COMPONENT LOCATION



2369223 S00061519081_V1

DEFUEL - COMPONENT LOCATION

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SIA ALL

EFFECTIVITY

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DEFUEL - DEFUEL VALVE

Purpose

The defuel valve connects the right engine fuel feed manifold with the defuel manifold. This permits removal of fuel from the fuel tanks.

Description

The defuel valve operates manually. It has these components:

- Handle
- Valve assembly.

Handle

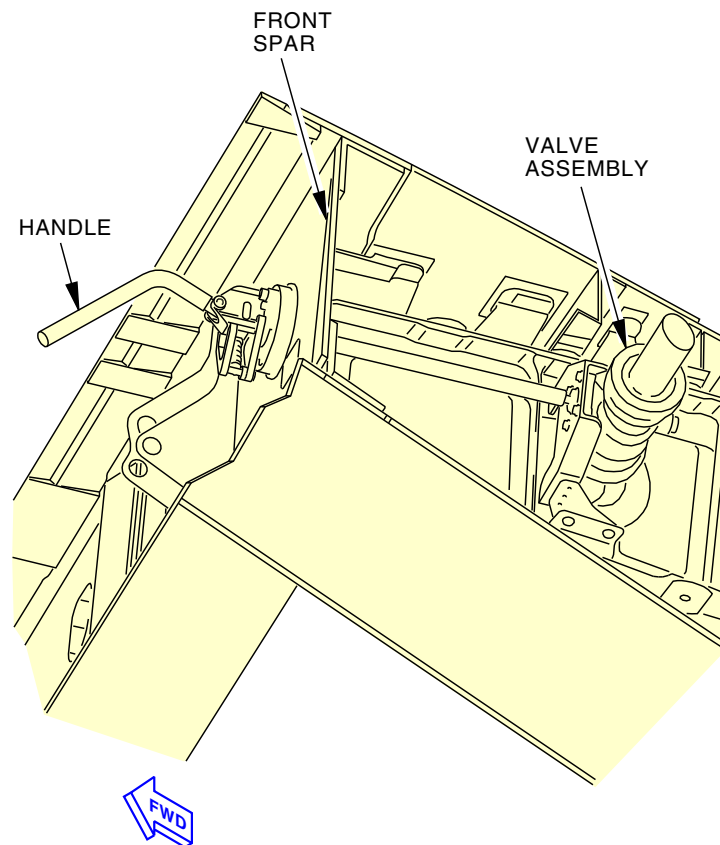
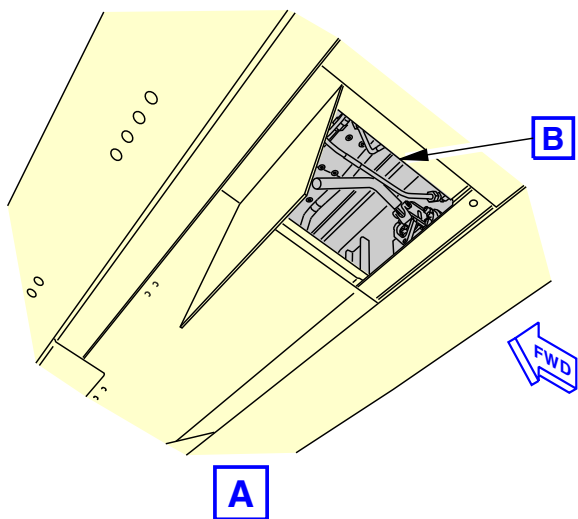
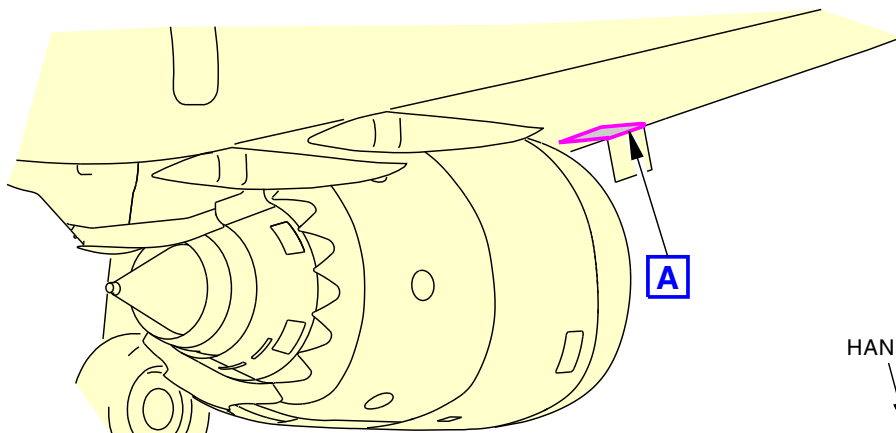
The handle operates the defuel valve. The handle is also a position indicator. You cannot close the defuel valve access door with the handle in the open position.

Valve Assembly

The valve assembly attaches to the structure inside the fuel tank. It connects to both the defuel manifold and the right engine fuel feed manifold.

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DEFUEL - DEFUEL VALVE



2369224 S00061519083_V1

DEFUEL - DEFUEL VALVE

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**DEFUEL - OPERATION****General**

There are two ways to defuel the fuel tanks, pressure defuel and suction defuel. You can pressure defuel any tank. You can only suction defuel main tank 1 and main tank 2. You can transfer fuel between any tank.

Suction defuel of main tank 1 will occur only if main tank 2 is suction defueled at the same time. When main tank 2 empties, air will be drawn into the manifold and fuel flow will stop.

Pressure Defuel

This is a summary of the pressure defuel procedure:

- Connect the refuel nozzles
- Move the handle on the defuel valve to the open position
- Turn on the boost pumps to the tank that you need to defuel
- Open the crossfeed valve, if necessary
- Turn the boost pumps off when the tank is empty
- Move the handle on the defuel valve to the closed position
- Disconnect the fueling nozzles.

Suction Defuel

This is a summary of the suction defuel procedure:

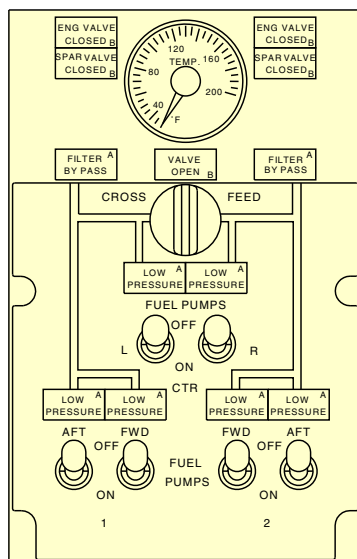
- Connect the fueling nozzles
- Move the handle on the defuel valve to the open position
- Open the crossfeed valve, if necessary
- Start to suction fuel with the ground source
- When the fuel tank is empty, move the handle on the defuel valve to the closed position
- Disconnect the fueling nozzles.

Fuel Transfer

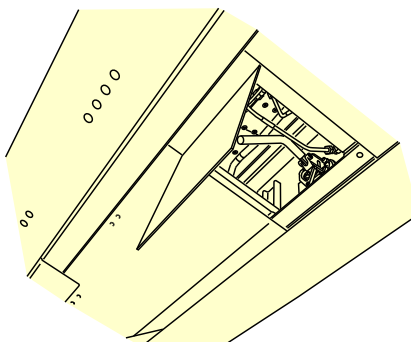
To transfer fuel between tanks you use the defuel system, fueling system, and the engine fuel feed system. This is a summary of the fuel transfer procedure:

- Move the defuel valve to the open position
- Turn on the boost pumps in the tank you want to defuel
- Open the crossfeed valve
- Move the refuel valve switch to the open position in the tank you want to put fuel into
- After fuel transfer, turn the boost pumps off
- Close the crossfeed valve
- Move the defuel valve to the closed position.

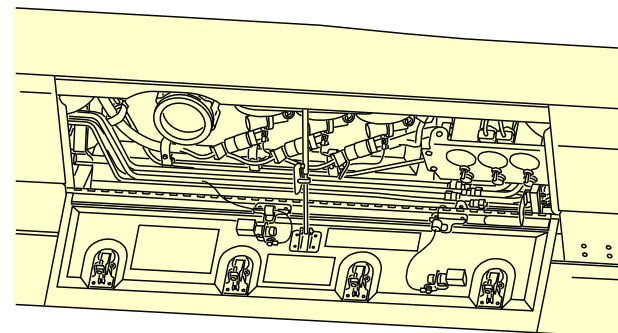
DEFUEL - OPERATION



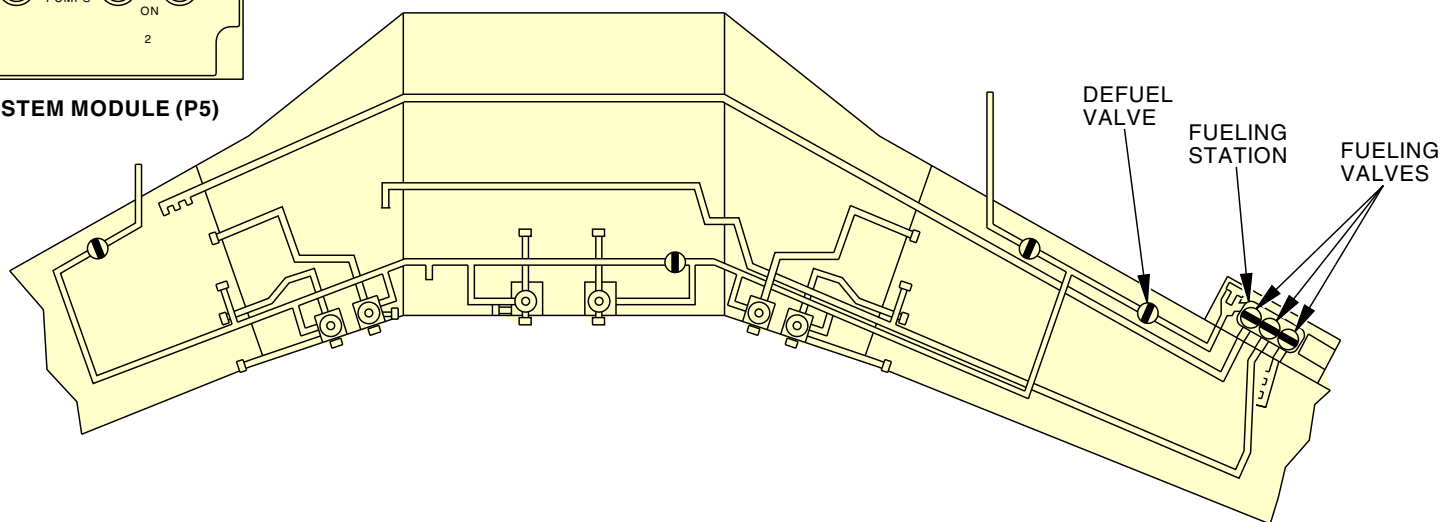
FUEL SYSTEM MODULE (P5)



DEFUEL VALVE



FUELING STATION (P15)



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DEFUEL - OPERATION

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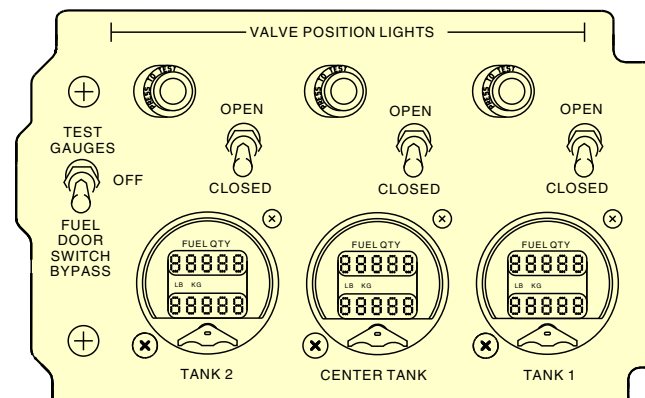
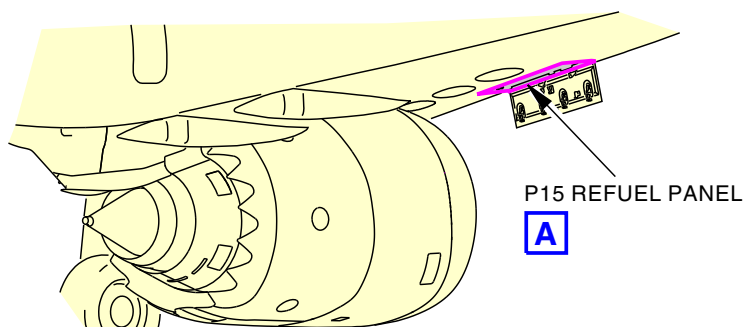
FUEL INDICATING - INTRODUCTION

Fuel Quantity Indicating System (FQIS)

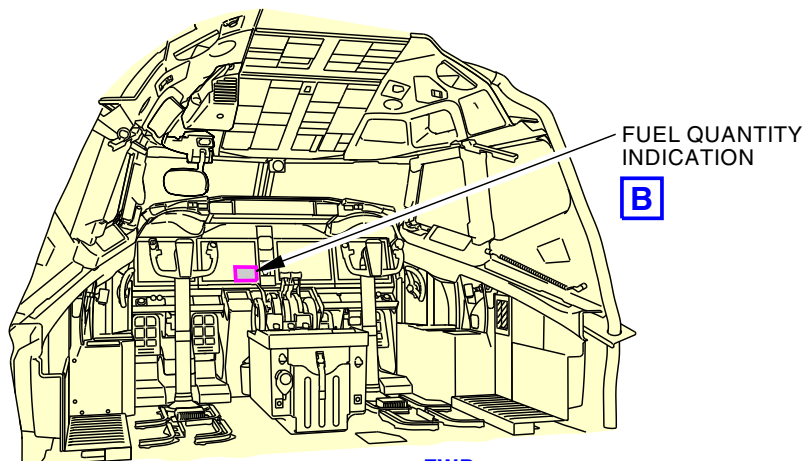
The Fuel Quantity Indicating System (FQIS) measures fuel quantity and calculates fuel weight. The MAX Display System (MDS) and the P15 refuel panel show fuel quantity.

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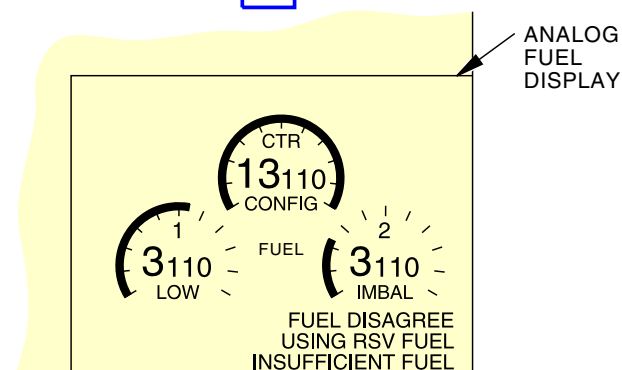
FUEL INDICATING - INTRODUCTION



P15 REFUEL PANEL
(EXAMPLE)
A



FLIGHT COMPARTMENT
FWD



FUEL QUANTITY INDICATION
B

NOTE:

ALL INDICATIONS ARE DISPLAYED IN KILOGRAMS OR POUNDS

2559244 S0000610534_V1

FUEL INDICATING - INTRODUCTION

28-41-00

**FUEL INDICATING - GENERAL DESCRIPTION****General**

The Fuel Quantity Indicating System (FQIS) calculates the fuel weight in the main tanks and the center tank. The Fuel Quantity Processor Unit (FQPU) calculates total fuel weight and supplies this to the Flight Management Computer System (FMCS). The fuel quantity of each tank shows on the MAX Display System (MDS).

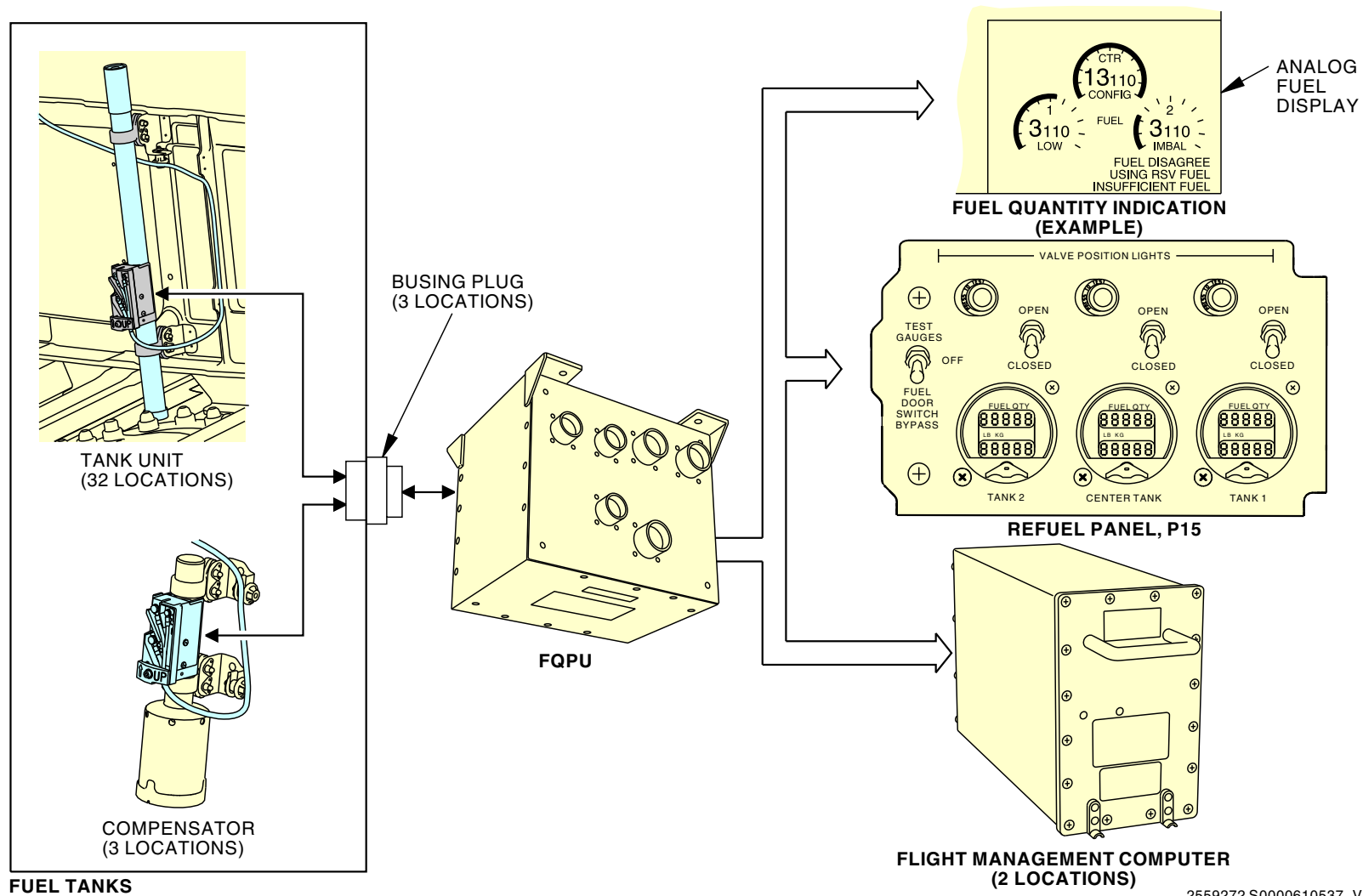
Operation

The FQPU sends an excitation to and receives signals from the tank units and the compensators. The FQPU uses these signals to calculate fuel quantity in each fuel tank.

Each refuel quantity indicator has an overfill indication. The quantity blinks on, then off, at a one second rate when the fuel in the tank is more than maximum rated capacity.

SIA ALL	EFFECTIVITY

FUEL INDICATING - GENERAL DESCRIPTION



2559272 S0000610537_V1

FUEL INDICATING - GENERAL DESCRIPTION



FUEL INDICATING - TANK UNITS AND COMPENSATORS

General

There are 32 tank units in the fuel tanks. There are 12 tank units in the No. 1 main tank and 12 tank units in the No. 2 main tank. There are 8 tank units in the center tank.

There is one compensator in each tank.

Tank Units

The tank units measure fuel weight. The Fuel Quantity Processor Unit (FQPU) sends a common low impedance excitation signal to the tank units. The tank units return a single high impedance signal to the processor. This high impedance return signal is in proportion to fuel weight for the entire tank.

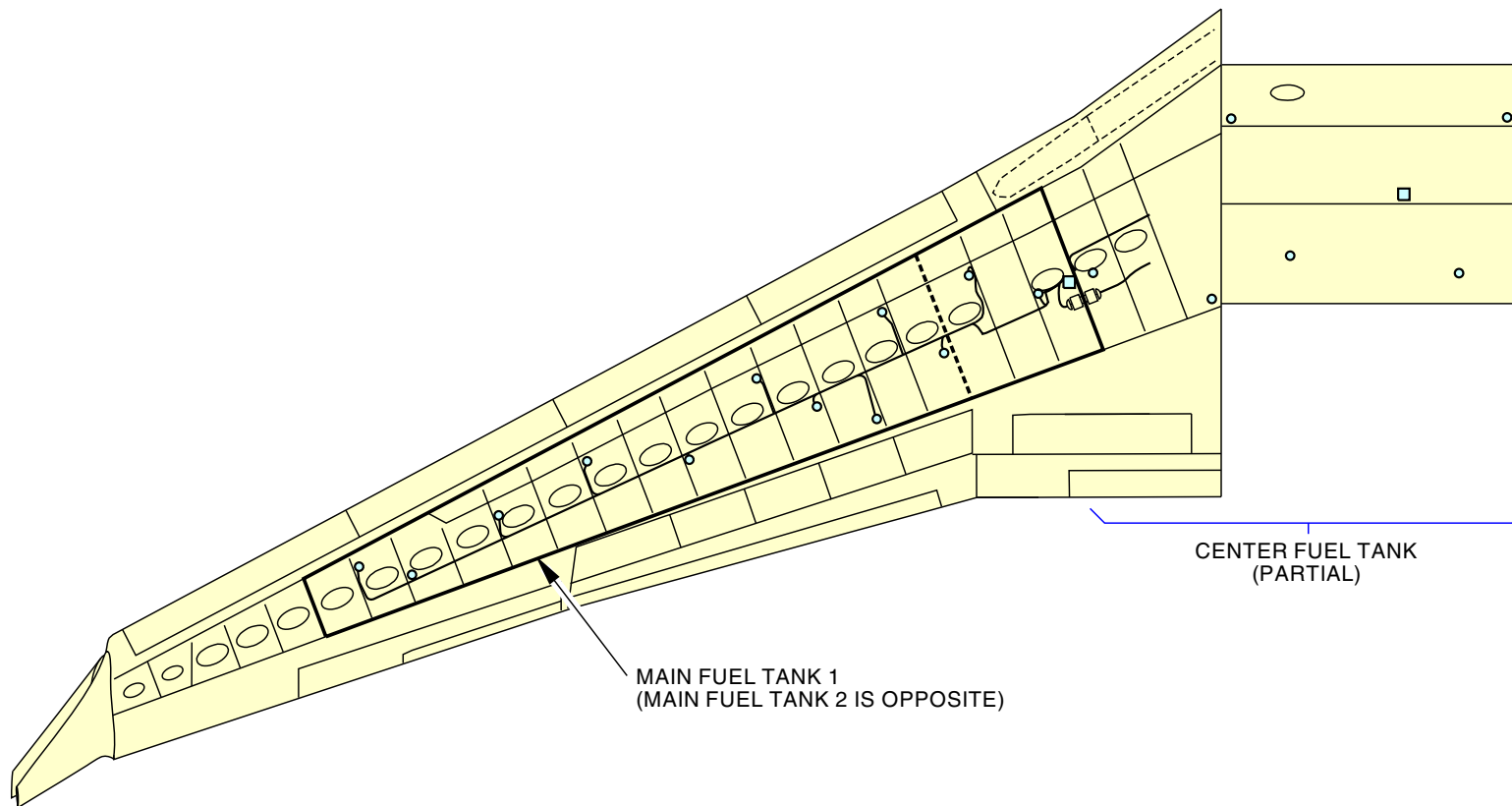
Compensators

The compensators correct for differences in fuel properties. The FQPU sends a low impedance signal to each compensator. The compensators return a high impedance signal to the processor. This high impedance return signal is in proportion to the dielectric of the fuel.

Each compensator is in the low point of its fuel tank. For most operations, fuel fully covers the compensator. The high impedance return signal from each compensator changes only for differences in fuel dielectric.

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FUEL INDICATING - TANK UNITS AND COMPENSATORS



LEGEND:

- - TANK UNIT (32 LOCATIONS)
- - COMPENSATOR (3 LOCATIONS)

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FUEL INDICATING - TANK UNITS AND COMPENSATORS

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EFFECTIVITY

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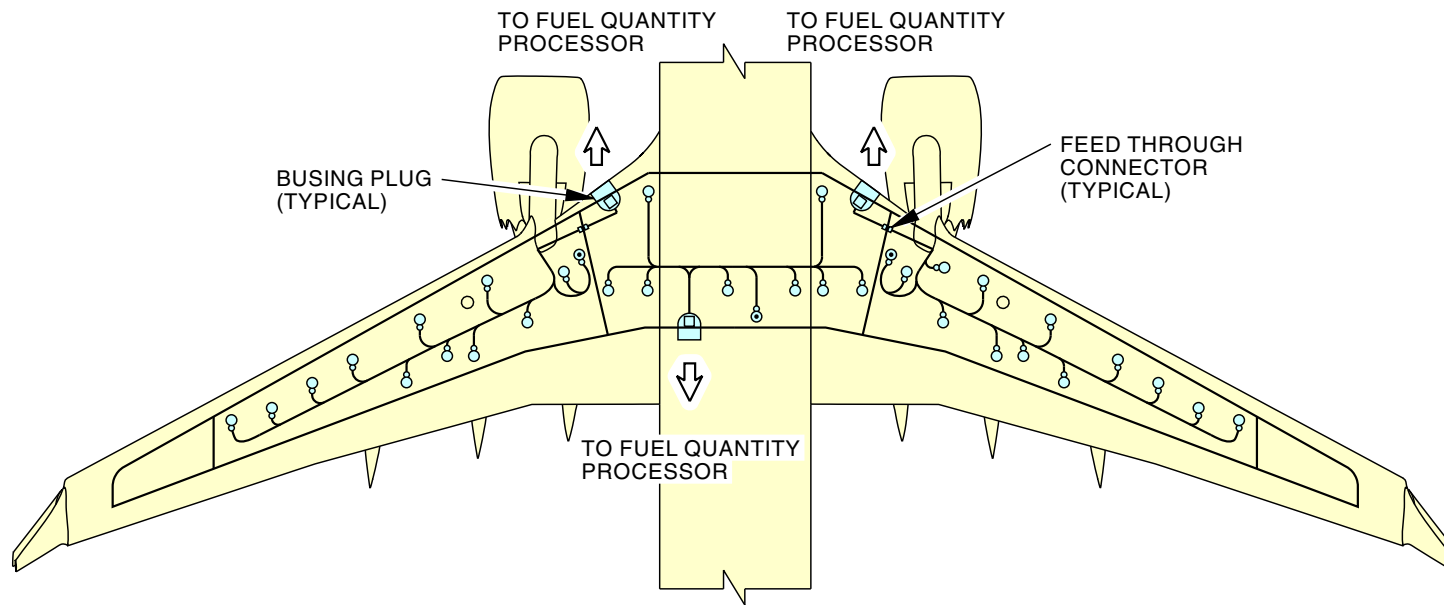
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**FUEL INDICATING - WIRE HARNESSES****General**

There is one wire harness in each fuel tank. Each wire harness connects to the fuel tank units and the compensator. Each wire harness connects to a feed through a connector in the fuel tank. Each spar connector attaches to a bussing plug. Each bussing plug connects to the Fuel Quantity Processor Unit (FQPU).

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FUEL INDICATING - WIRE HARNESSES



LEGEND:

- TANK UNIT
- ⊙ COMPENSATOR

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FUEL INDICATING - WIRE HARNESSES

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EFFECTIVITY

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FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT

Purpose

The Fuel Quantity Processor Unit (FQPU) does these functions:

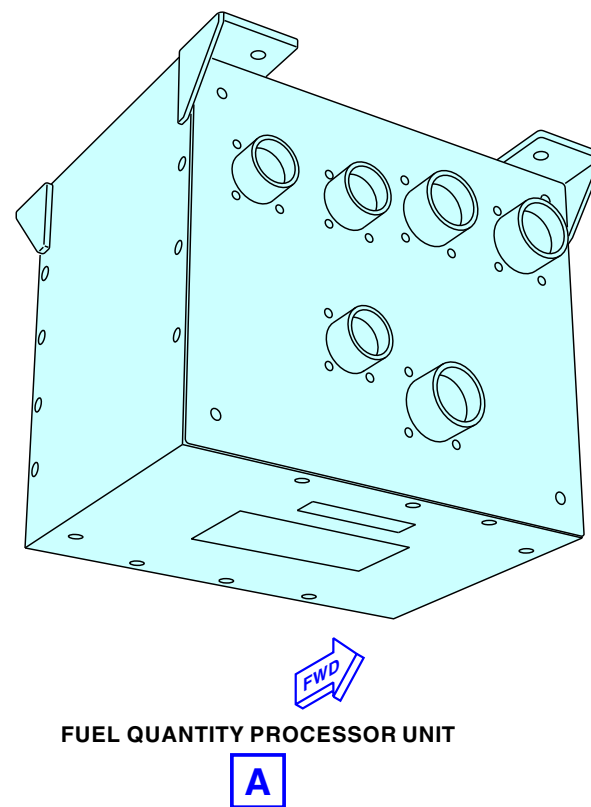
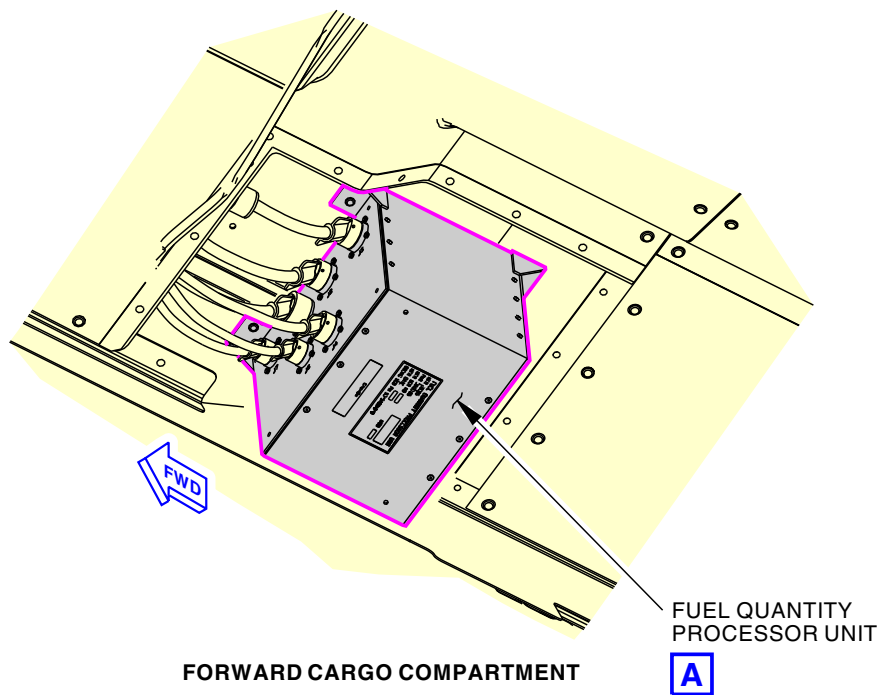
- Calculates fuel weight in each tank
- Calculates the total fuel weight
- Sends fuel weight to the MAX Display System (MDS)
- Sends fuel weight to the P15 refuel panel
- Sends fuel weight to the flight management computer
- Monitors the fuel system for faults
- Stores faults in non-volatile memory
- Sends fault data to the control display units

Location

The FQPU is located in the ceiling of the forward cargo compartment forward of the cargo door.

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FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT

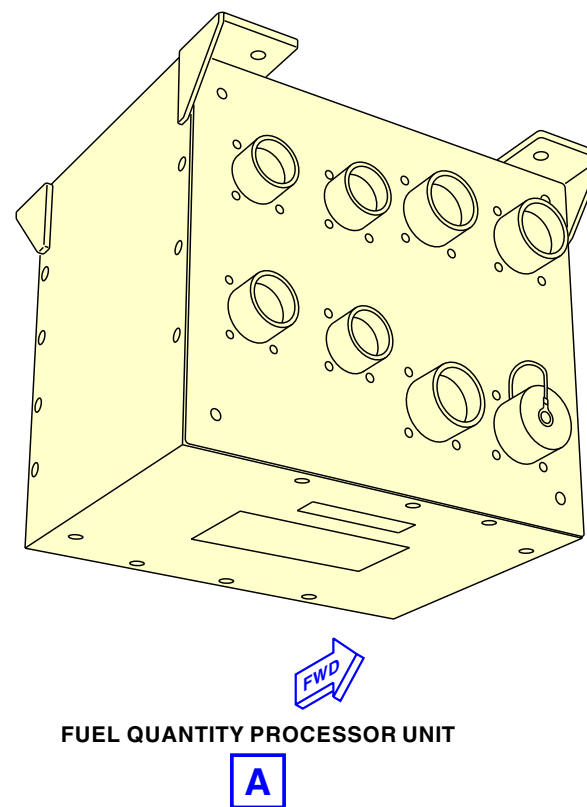
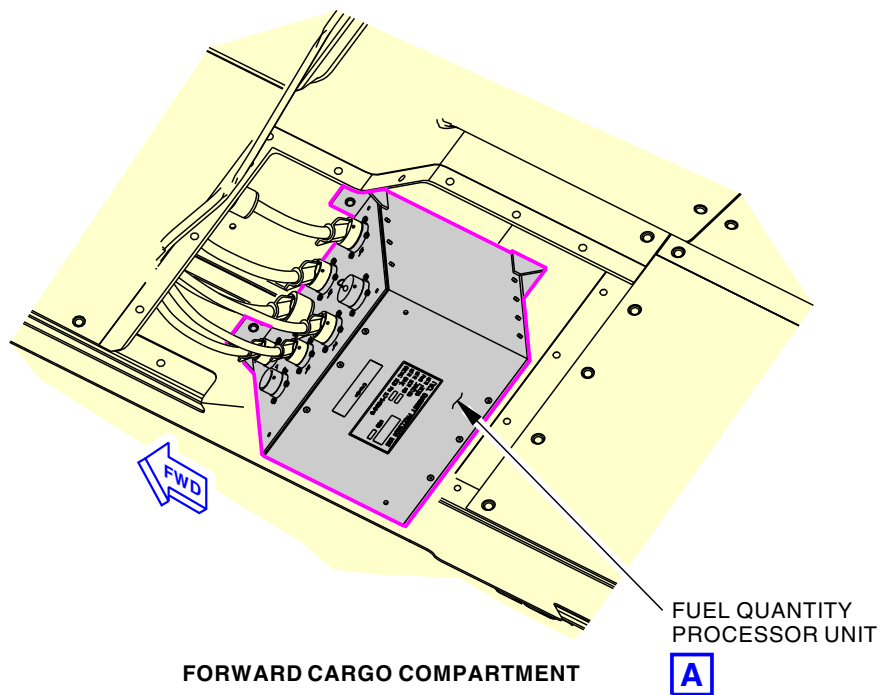


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FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT

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FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT



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FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT

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**FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT - POWER****General**

The Fuel Quantity Processor Unit (FQPU) connects to two isolated 28V DC power sources at a time. The FQPU operates when one or two of the sources have power.

Power Sources

The FQPU can receive power from any of these three sources:

- 28V DC bus 1
- 28V DC hot battery bus
- 28V DC battery bus

The power source normally available is the 28V DC battery bus. Transformer rectifier 3 (TRU3) is the normal power source for this bus. However, the battery or battery charger may also supply power to this bus if TRU3 power is not available and the battery switch is in the ON position.

When the fueling station door is in the closed position, processor unit power can come from DC bus 1. You must have AC power on the airplane to power this bus.

When the fueling station door is open and ground power is available, processor unit power can come from the 28V DC hot battery bus. The battery supplies power to this bus. It is not necessary to put the battery switch in the ON position for the battery to power this bus.

When the fueling indication test switch is in the FUEL DOOR BYPASS SWITCH position, processor unit power comes from the 28V DC hot battery bus.

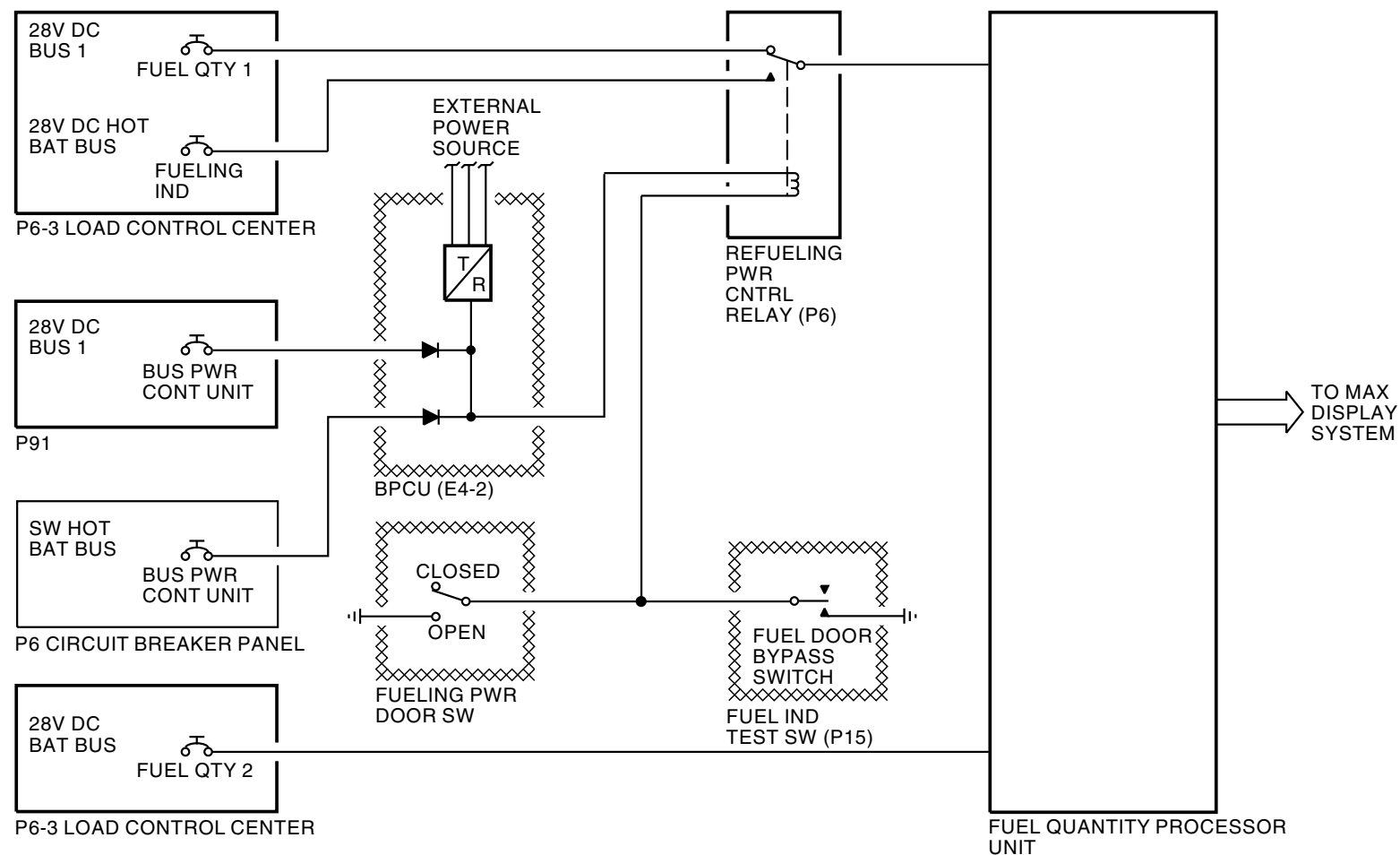
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FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT - POWER



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FUEL INDICATING - FUEL QUANTITY PROCESSOR UNIT - POWER

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**FUEL INDICATING - PROCESSOR - FUNCTIONAL DESCRIPTION****General**

The Fuel Quantity Processor Unit (FQPU) has three Signal Conditioner Circuit Cards (SCCC) and a BITE Display Card (BDC).

Fuel quantity for the main tanks and the center tank shows on the MAX Display System (MDS).

Signal Conditioner Circuit Cards

There is one SCCC for each fuel tank. Each SCCC has these functions:

- Sends a low Z signal to the tank units and compensator
- Reads the high Z return signal from the tank units and compensators
- Calculates total fuel weight for its tank
- Changes analog signals to ARINC 429 signals
- Sends tank fuel weight data to the display processing computer (DPC)
- Sends real time fault data to the BDC

The No. 2 tank SCCC also sends total fuel tank weight to the Flight Management Computer System (FMCS).

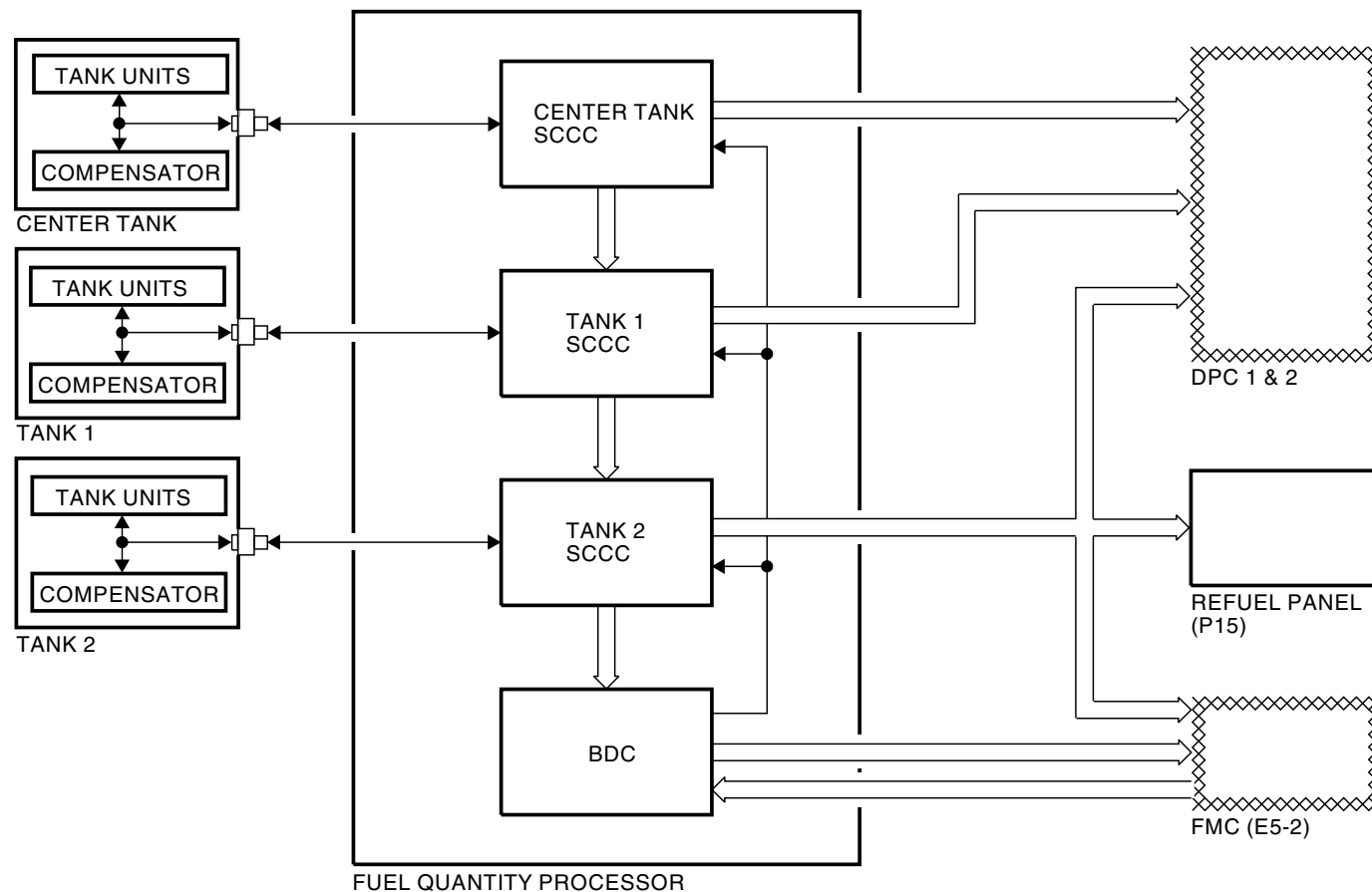
BITE Display Card

The BDC has these functions:

- Keeps fault data in non-volatile memory
- Sends a signal to each SCCC to start a real time test for fault isolation
- Sends and receives fault data with the FMCS for fault isolation

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FUEL INDICATING - PROCESSOR - FUNCTIONAL DESCRIPTION



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FUEL INDICATING - PROCESSOR - FUNCTIONAL DESCRIPTION

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EFFECTIVITY

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FUEL INDICATING - FUEL QUANTITY INDICATIONS

General

Individual fuel tank quantity shows on the MAX Display System (MDS) and the P15 refuel panel.

Fuel quantity shows in pounds or kilograms.

Fuel Configuration Messages

Fuel configuration messages show on the MDS. These messages show a problem with the configuration of the fuel system.

The LOW message shows that either No. 1 main tank or No. 2 main tank has less than 2000 lb (907 kg) of fuel. This message goes away when there is more than 2500 lb (1134 kg) of fuel in that tank. The low fuel condition must exist for 30 seconds before the LOW message shows.

The IMBAL message shows when there is a difference of 1000 lb (454 kg) between No. 1 main tank or No. 2 main tank. The message goes away when the difference between tanks is 200 lb (91 kg) or less. The IMBAL message only shows when the airplane is in the air. The IMBAL message does not show when the LOW message shows. The imbalance condition must exist for 60 seconds before the IMBAL message shows.

The CONFIG message shows when all of these conditions exist:

- 1600 lb (726 kg) or more of fuel in the center tank
- Both center tank fuel boost pump switches are off
- Either engine is in operation.

After the CONFIG message shows, it stays on until one or more of these conditions are true:

- 800 lb (363 kg) or less of fuel in the center tank
- A minimum of one center fuel boost pump is producing high pressure
- The two engines are not in operation

Fuel and Engine Alert Messages

The fuel and engine alert messages show on the Engine Indication (EI) display of the MDS.

The ENG FUEL FLOW alert message shows on the EI as an engine crew alert. The message shows that the Flight Management Computer (FMC) predicted fuel flow is different than the indicated fuel flow at power settings.

The FUEL DISAGREE message shows in the fuel display field adjacent to the TOTAL fuel load. It shows when the FMC and the fuel quantity processor unit (FQPU) do not agree.

The USING RSV FUEL message shows in the fuel display at the bottom right corner of the display. It shows when predicted fuel at the destination is less than the FMC calculates for reserve fuel. The white Control Display Unit (CDU) message (MSG) Light also comes on.

The INSUFFICIENT FUEL message shows in the fuel display on the bottom left side below the TOTAL fuel indication. It shows when predicted fuel shows less than 2000 lb (907 kg) at the destination.

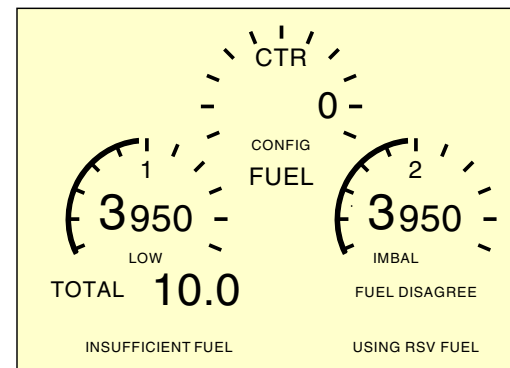
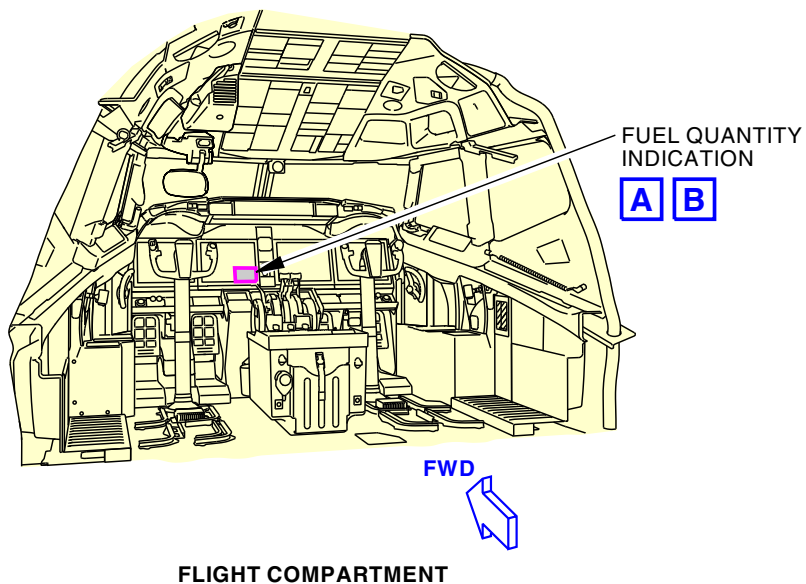
The amber FMC alert light on each pilot's instrument panel comes on when an alert message shows in the CDU scratch pad. The CDU MSG light also comes on.

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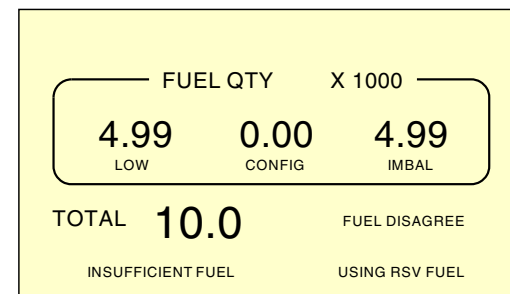
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FUEL INDICATING - FUEL QUANTITY INDICATIONS



FUEL QUANTITY INDICATION - ANALOG OPTION

A



FUEL QUANTITY INDICATION - DIGITAL OPTION

B

NOTE:

ALL INDICATIONS ARE DISPLAYED IN KILOGRAMS OR POUNDS.

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FUEL INDICATING - FUEL QUANTITY INDICATIONS

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FUEL TEMPERATURE INDICATING SYSTEM

Purpose

The fuel temperature indicating system consists of a fuel temperature indicator and a fuel temperature bulb (sensor) that shows the current fuel temperature in the No. 1 main tank. The fuel temperature in the fuel tank is monitored to make sure that the fuel temperature stays within the correct temperature limits. High altitude flights during cruise can cause the fuel temperature to decrease and can go below the freezing temperature of water. When this occurs, the suspended water can freeze into solid ice particles. When a sufficient amount of ice particles come together they create chunks of ice that mixes with the fuel. The chunks of ice can accumulate in the filters, engine controls and other fuel system components which can cause blockage or damage.

Location

The fuel temperature bulb is located on the rear spar of the No. 1 main tank. The fuel temperature indicator is located in the flight compartment in the Fuel System Module, P5-2.

Components

These are the components of the fuel temperature indicating system:

- Fuel temperature indicator
- Fuel temperature bulb.

Fuel Temperature Indicator

The fuel temperature indicator is installed in the Fuel System Module (P5-2) and is secured to the module by a ring clamp. The fuel temperature indicator is a ratiometer that operates with 28 VAC power and has an internal lighting system that operates on 5 VAC power.

Fuel Temperature Bulb

The fuel temperature bulb is an electrical resistance temperature sensor that measures the fuel temperature. The fuel temperature bulb is installed in an adapter housing that isolates the fuel temperature sensor from the fuel.

Operation

The fuel temperature indicating system operates on 28 VAC power to energize the system. The electrical power supplies the fuel temperature indicator and receives electrical resistance changes from the fuel temperature bulb. The electrical resistance moves the pointer on the fuel temperature indicator. When the fuel warms, the indicator pointer moves clockwise and counterclockwise when the fuel cools.

When electrical power is removed, the indicator pointer automatically moves counterclockwise and stops past the scale.

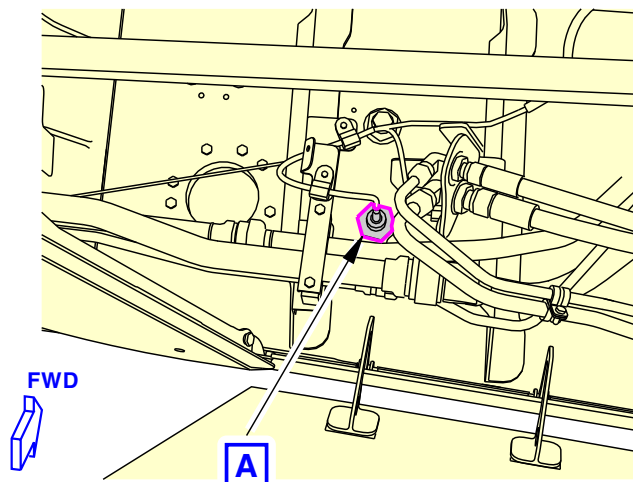
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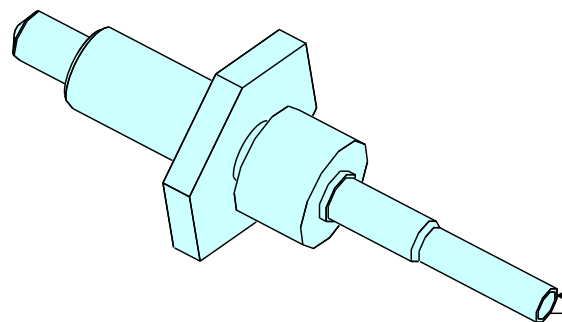
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FUEL TEMPERATURE INDICATING SYSTEM

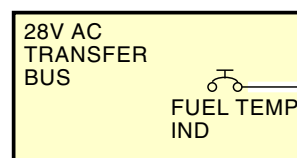


REAR SPAR LEFT WING

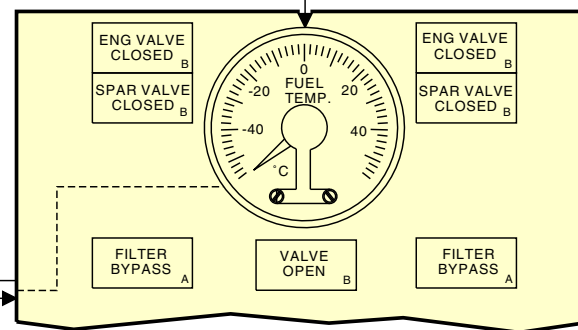


FUEL TEMPERATURE BULB AND
ADAPTER HOUSING

A



P6 CB PANEL



FUEL SYSTEM MODULE (P5-2)

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FUEL TEMPERATURE INDICATING SYSTEM



FUEL TEMPERATURE INDICATING SYSTEM

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FUEL MEASURING STICK - INTRODUCTION

General

You manually measure fuel quantity with the fuel measuring sticks.

There are six measuring sticks in main tank 1 and main tank 2. Each fuel measuring stick is on a fuel tank access door. The fuel measuring sticks are numbered 3 through 8, from inboard to outboard.

There are four fuel tank measuring sticks in the center tank. Two fuel tank measuring sticks are on fuel tank access panels and two are on the wing skin. The center tank fuel measuring sticks are numbered 1 and 2, from inboard to outboard.

The inner sticks have graduation marks that show fuel height in linear units.

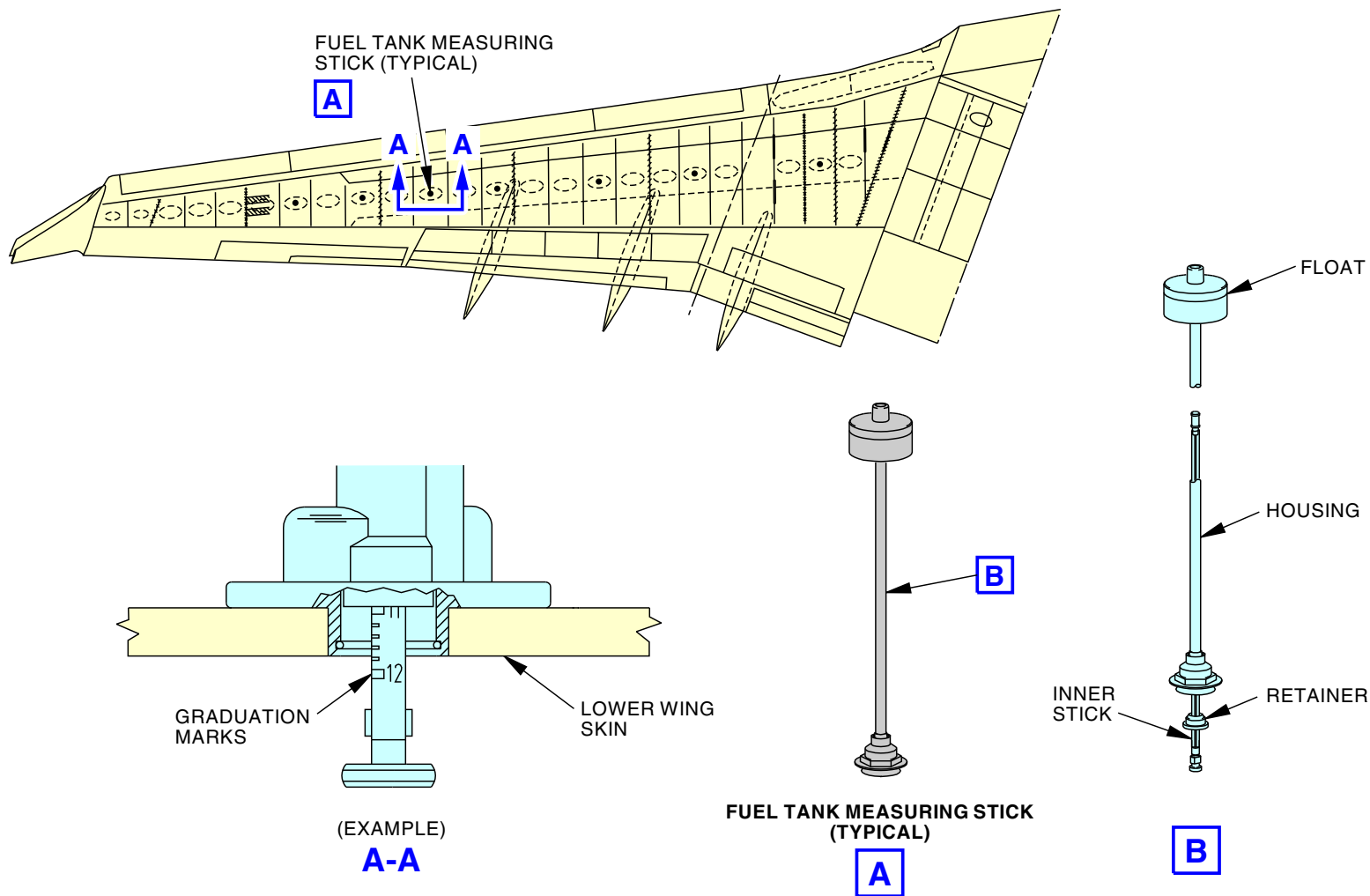
There are two inclinometers, one for airplane pitch, one for airplane roll, in the main landing gear wheel well.

There is also plumb bob attachment and a leveling scale in the right main wheel well. You use the plumb bob and leveling scale to determine airplane pitch and roll.

You use fuel height the linear unit measurement and airplane pitch and roll to measure fuel quantity. Chapter 12 of the AMM Part II has conversion tables that change linear units, fuel height, and airplane pitch and roll into fuel quantity.

EFFECTIVITY	
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FUEL MEASURING STICK - INTRODUCTION



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FUEL MEASURING STICK - INTRODUCTION

